Ryan Harvey, MD
Clinical Assistant Professor, FSU College of Medicine
Chair, Radiology, Sarasota Memorial Hospital
President, Radiology Associates of Florida

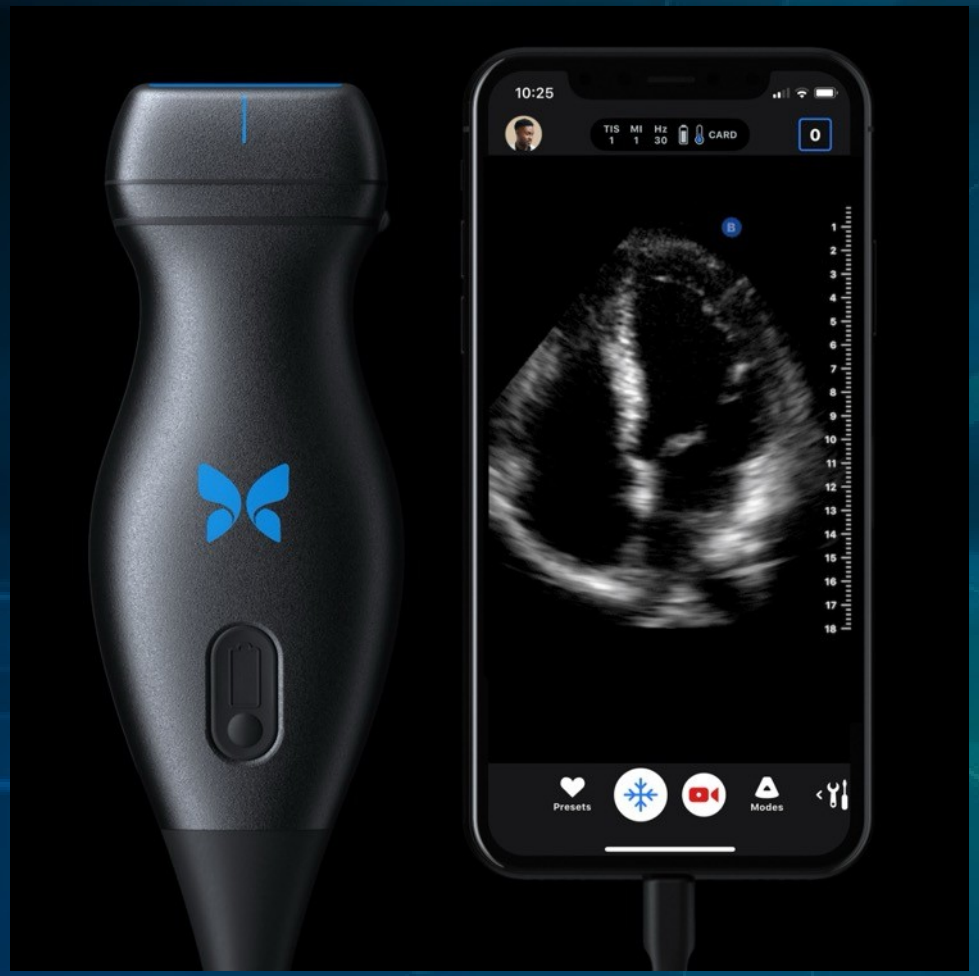
RADIOLOGY | *For the Internal Medicine Physician*

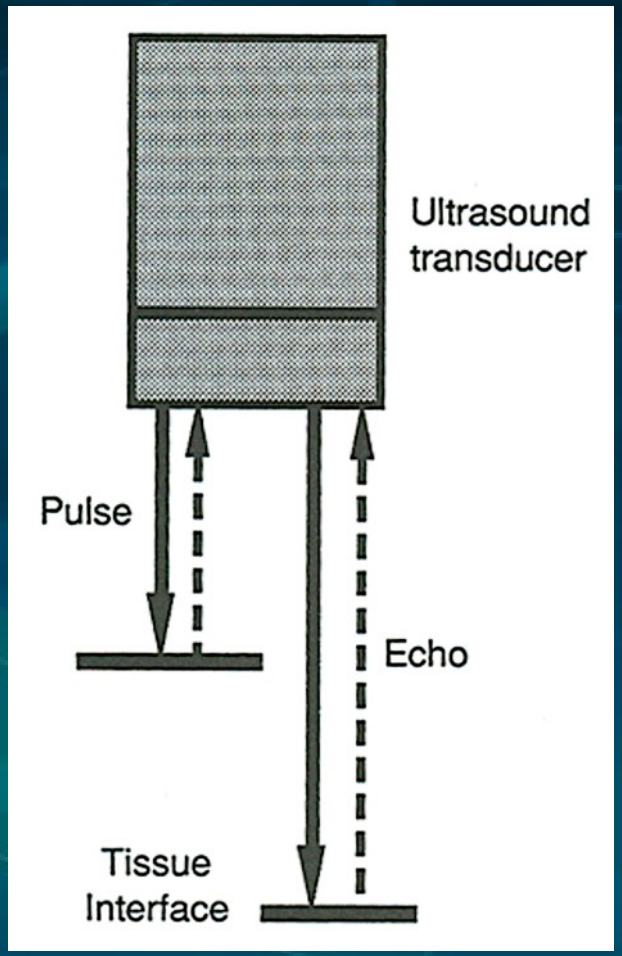
- **Ultrasound**
- **CT**
- **Contrast Safety**
- **Cases**

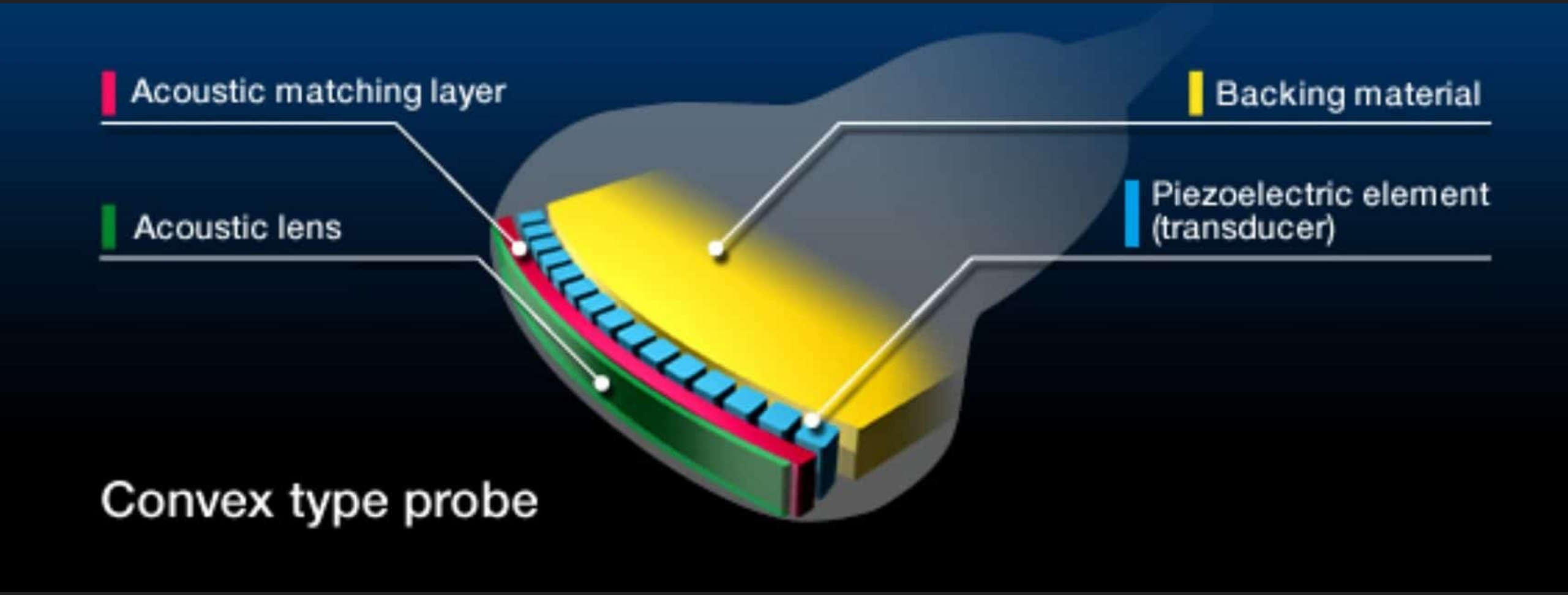
Ryan Harvey, MD
Clinical Assistant Professor, FSU College of Medicine
Chair, Radiology, Sarasota Memorial Hospital
President, Radiology Associates of Florida

RADIOLOGY | *For the Internal Medicine Physician*

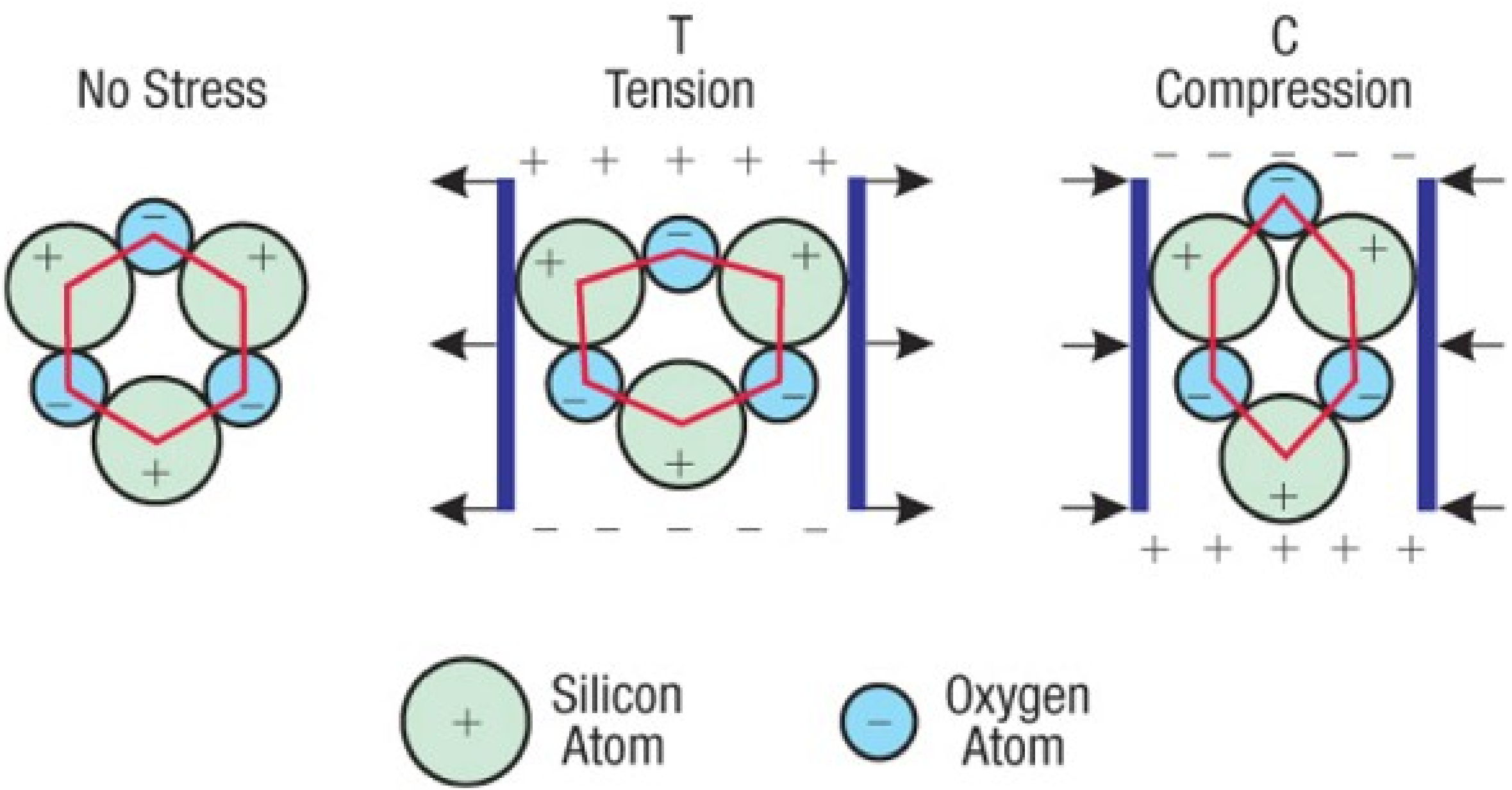
Ultrasound

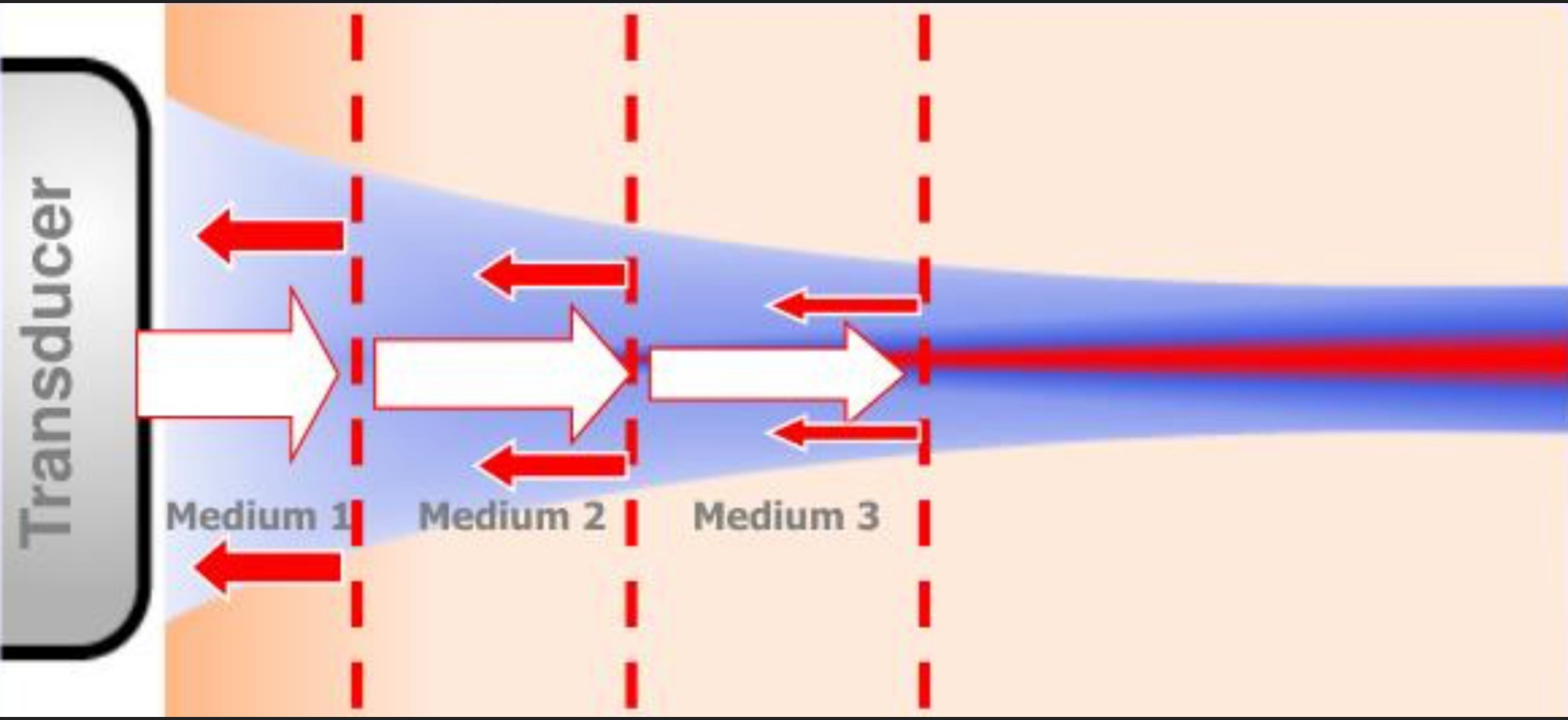

10:25
TIS MI Hz
1 1 30
CARD
0
Presets
Modes


Ultrasound transducer
Pulse
Echo
Tissue Interface


Acoustic matching layer
Acoustic lens
Backing material
Piezoelectric element
(transducer)
Convex type probe

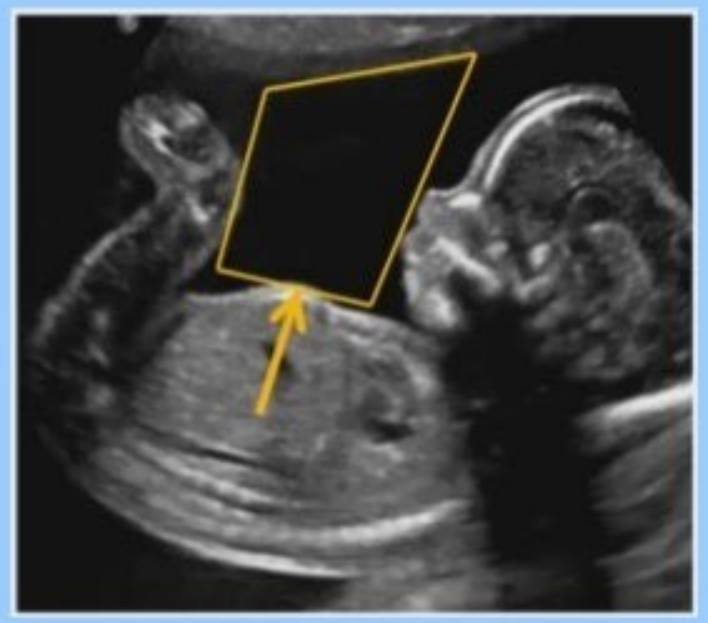
Piezoelectric Effect in Quartz




Transducer
Medium 1
Medium 2
Medium 3

Echogenicity (caused by Reflection)

Ane-Echoic

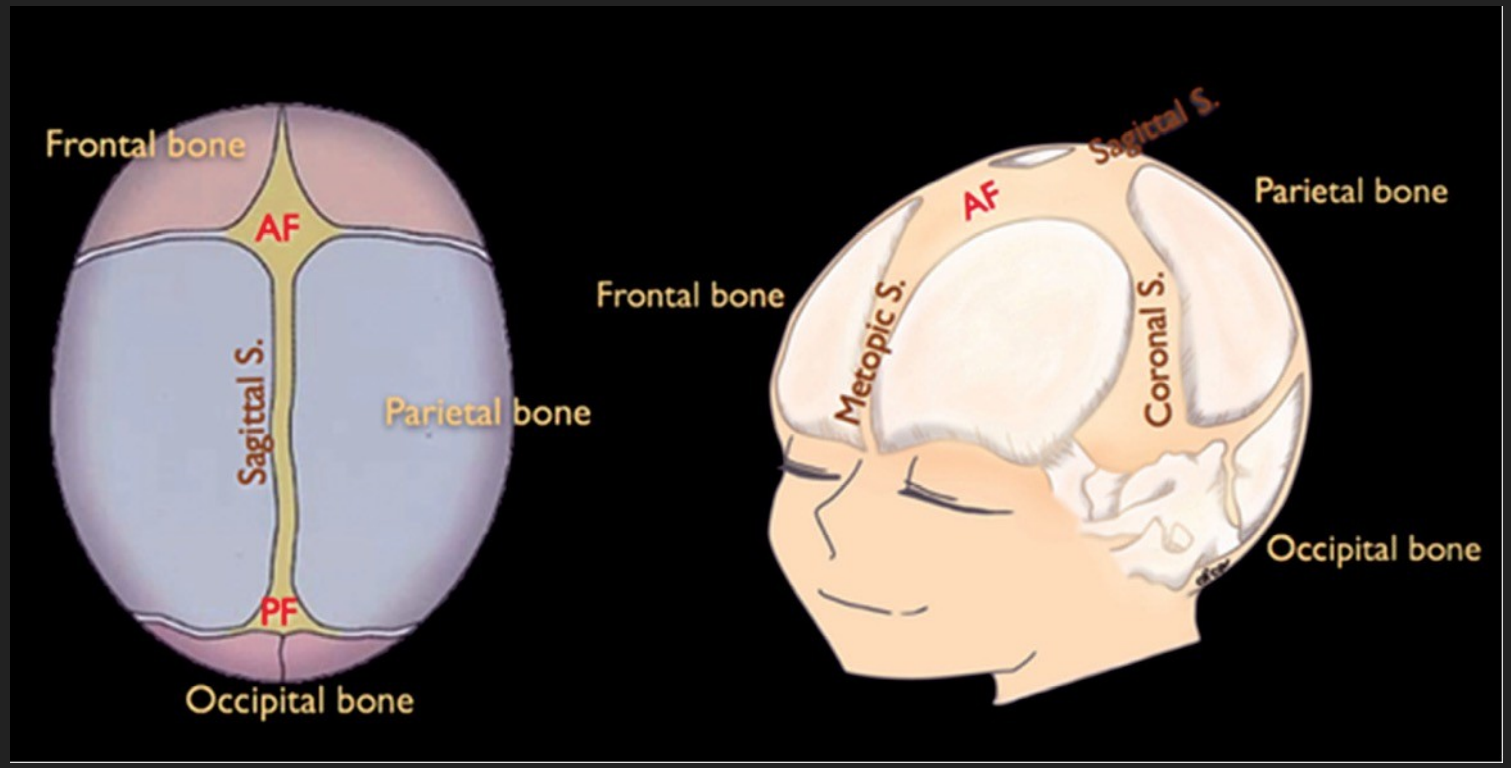


Hypeo-Echoic

Hyper-Echoic

ACOUSTIC WINDOWS

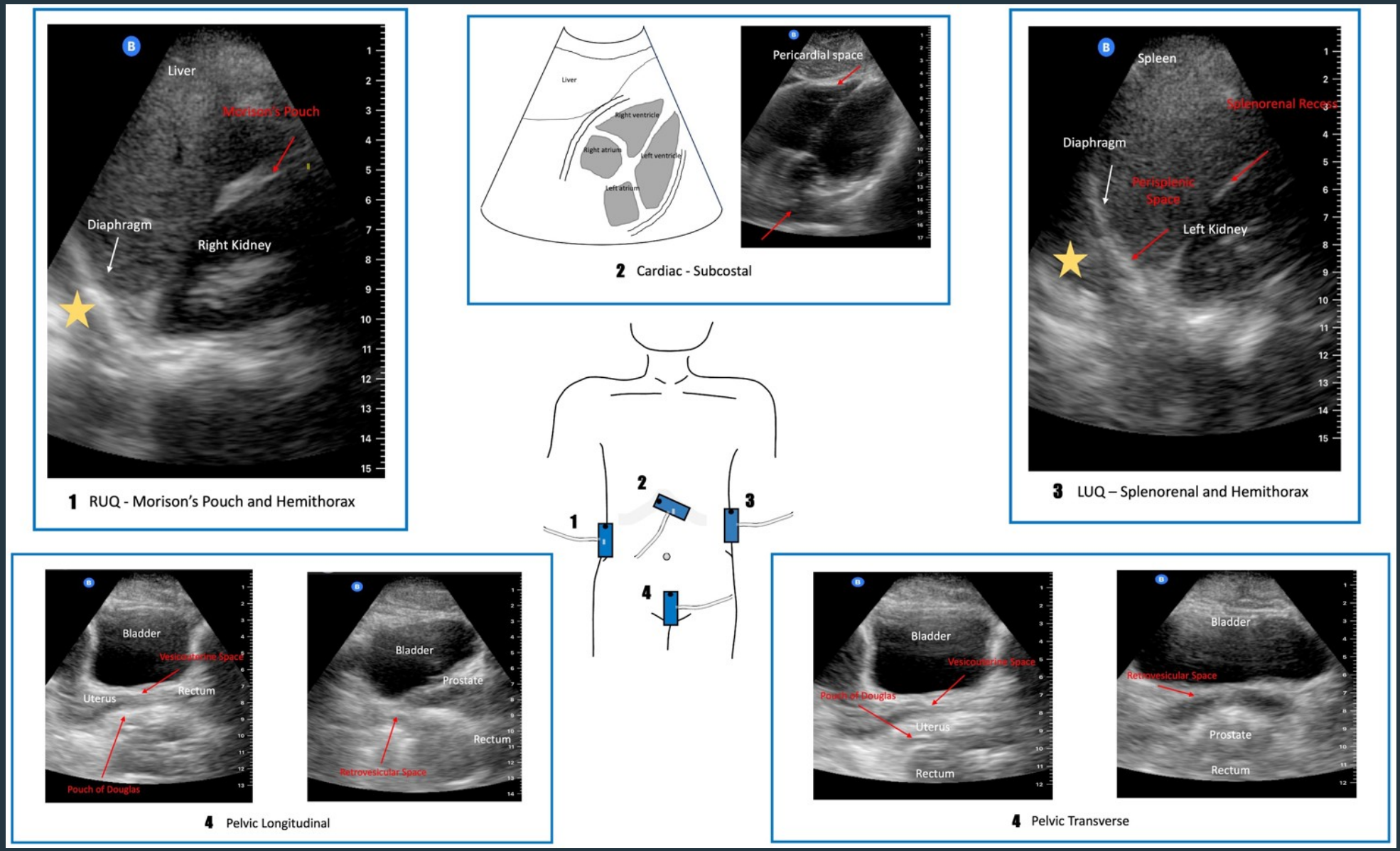
- Fontanelles
- Intercostal spaces
- Liver
- Bladder



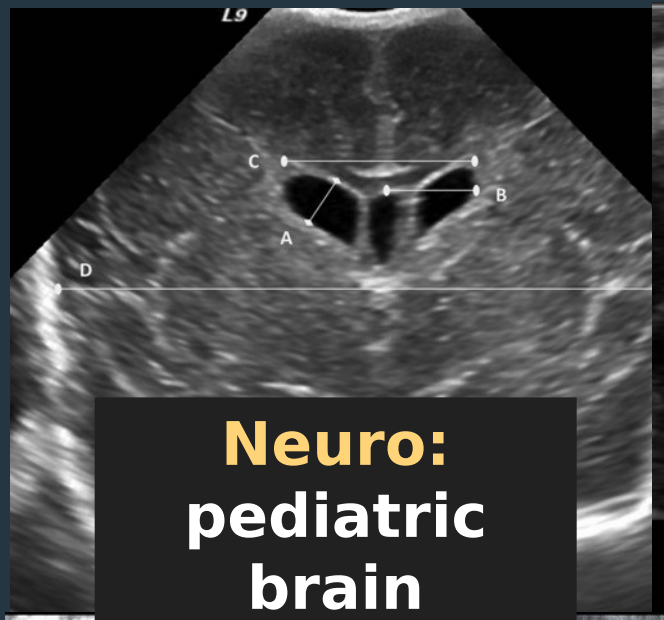
Point-of-Care Ultrasound (POCUS) for IM

- ✓Pleural effusion
- ✓Ascites
- ✓Cholecystitis
- ✓Hydronephrosis
- ✓Urinary retention
- ✓DVT
- ✓Abscess
- ✓Joint effusion
- ✓AAA
- ✓IVC (volume status)
- ✓Trauma FAST exam
- ✓Procedure guidance

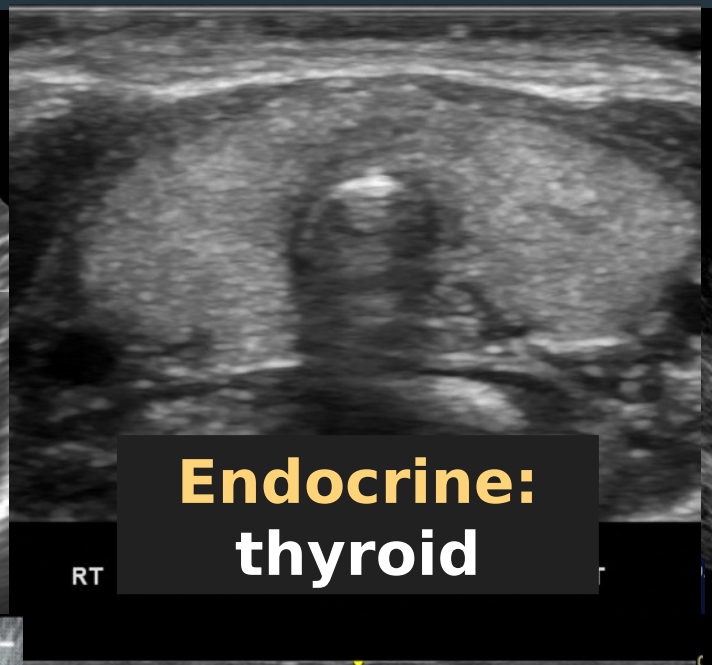
used Assessment with Sonography in Trauma (FA



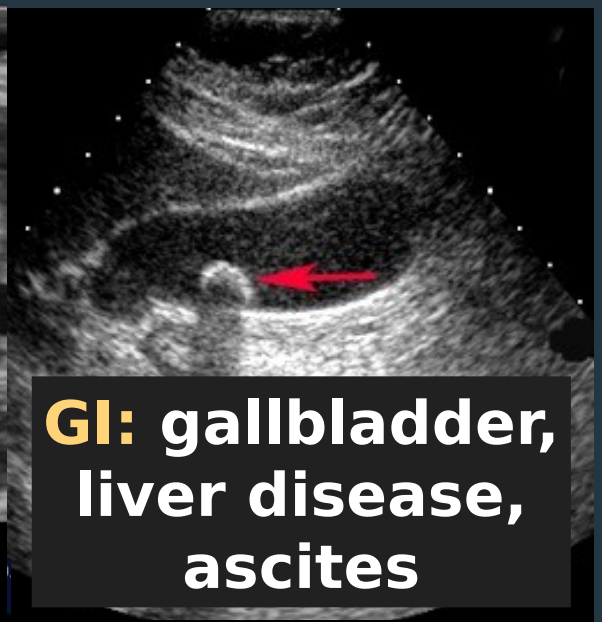
ULTRASOUND: USES



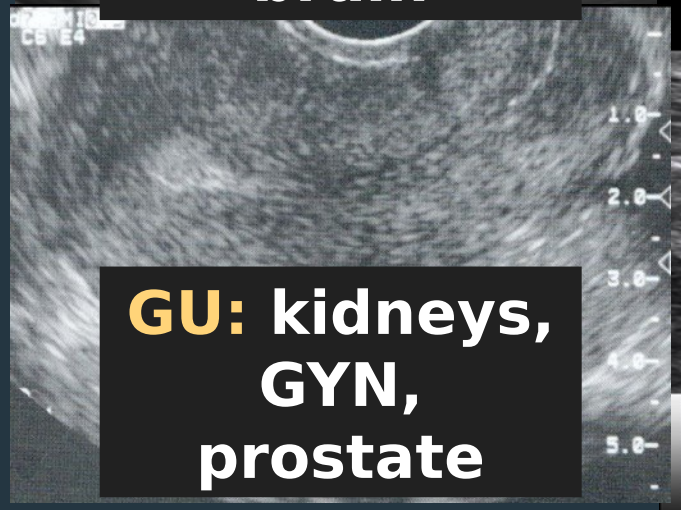
Neuro: pediatric brain



Endocrine: thyroid

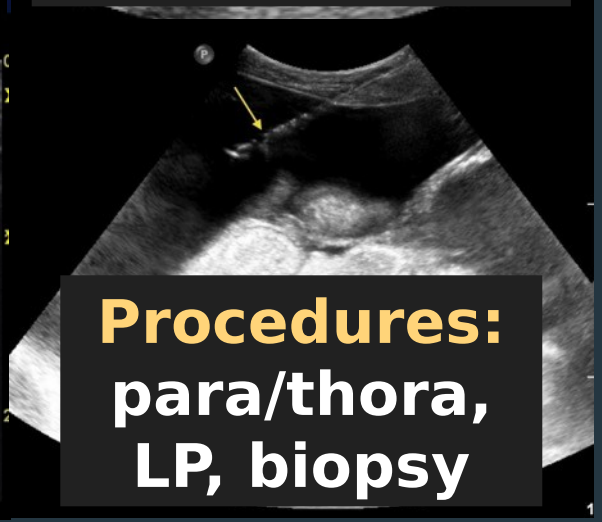


GI: gallbladder, liver disease, ascites



GU: kidneys, GYN, prostate

MSK: arthritis, sports injury



Procedures: para/thora, LP, biopsy

“Diagnosis by density difference”

CT Concepts

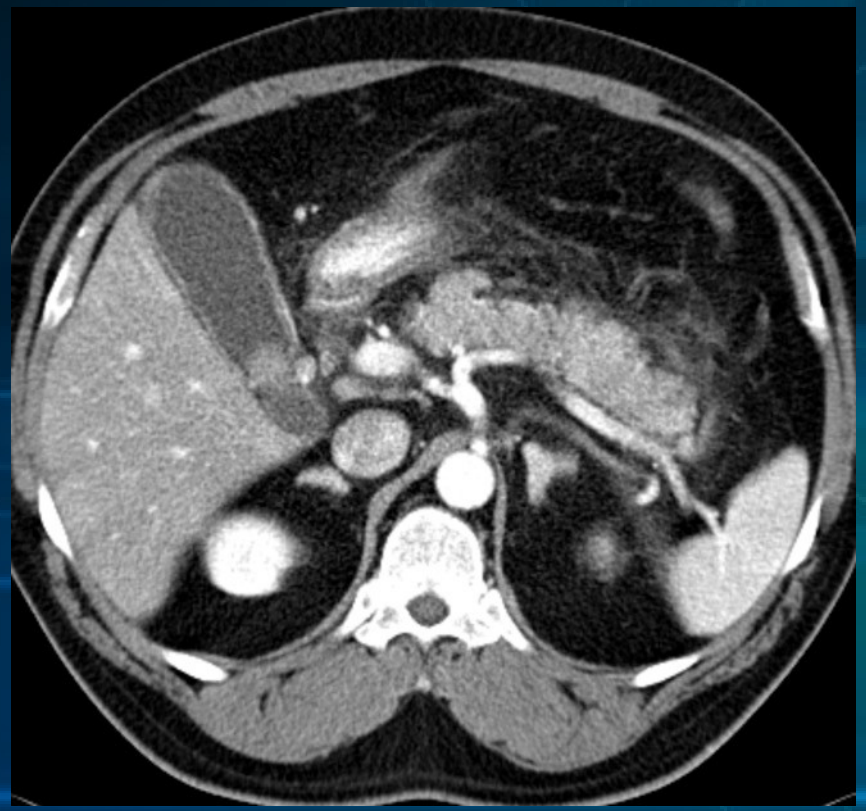
Computed Tomography : Concepts

- **Density**

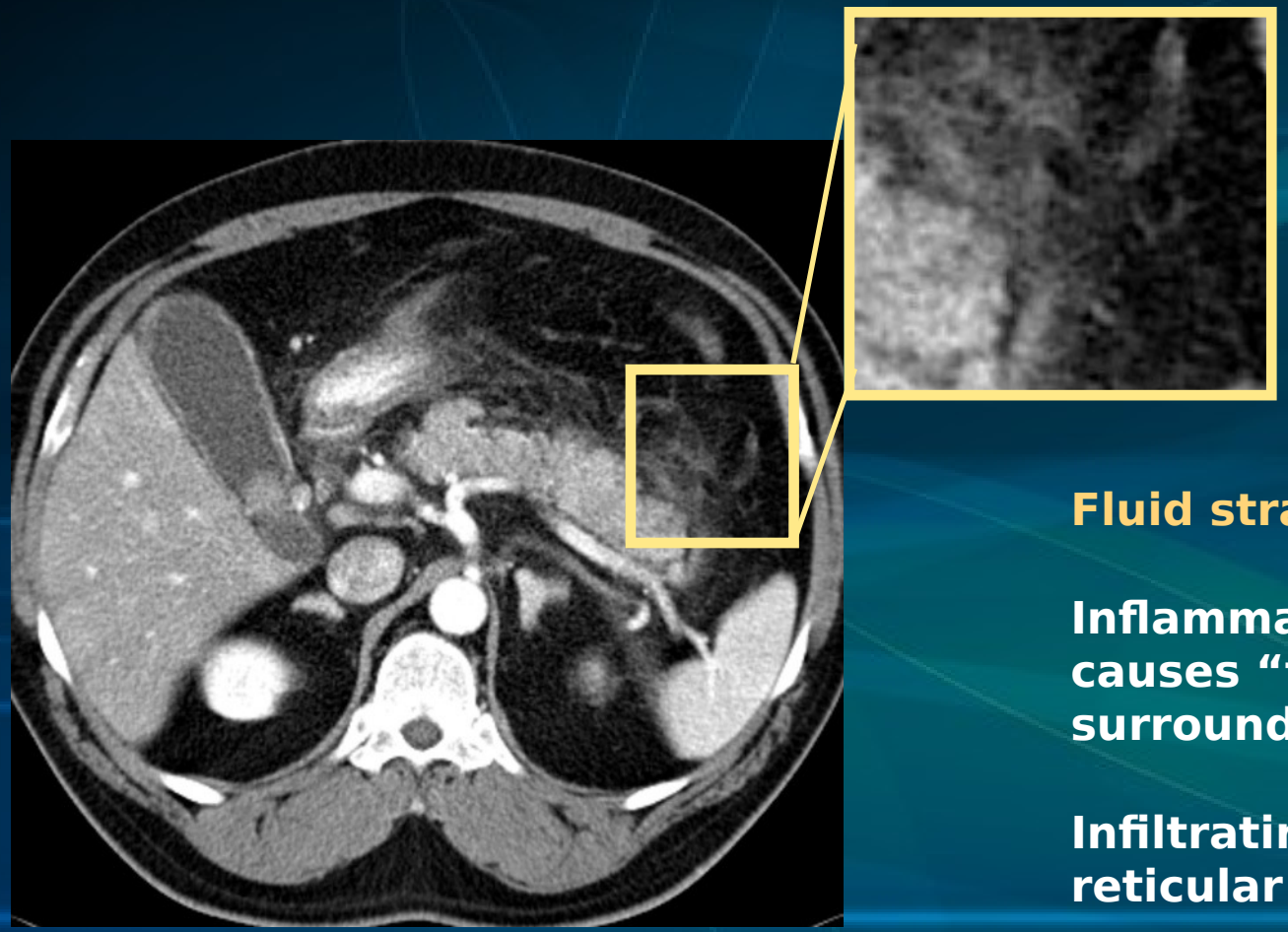
  Hounsfield Units

Air (-1000 H) Fat (-100 H) Water (0 H) Blood (40 H) Bone (1000 H)

CT Concepts: Stranding



CT Concepts: Stranding

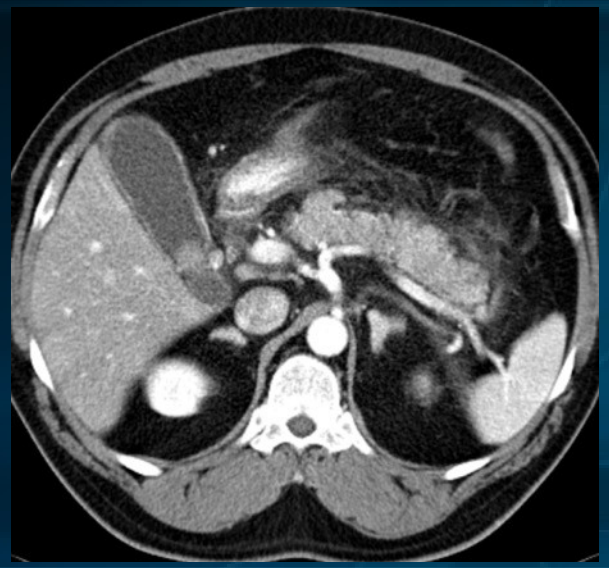


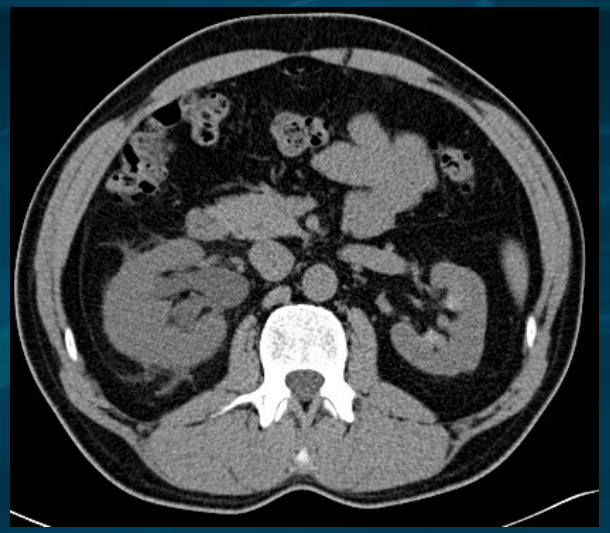
Fluid stranding

Inflammation or edema causes “fluid stranding” in surrounding soft tissues

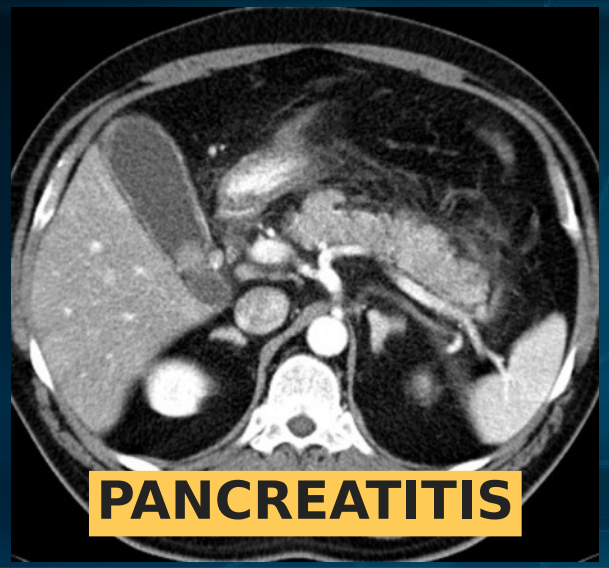
Infiltrating band-like or reticular opacities

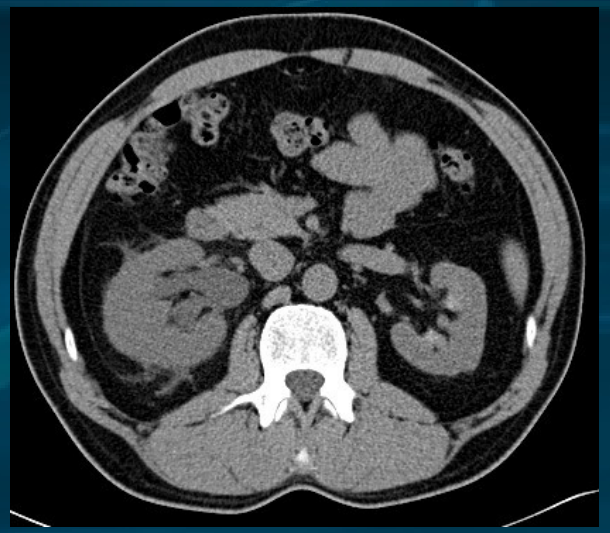
CT Concepts: Stranding



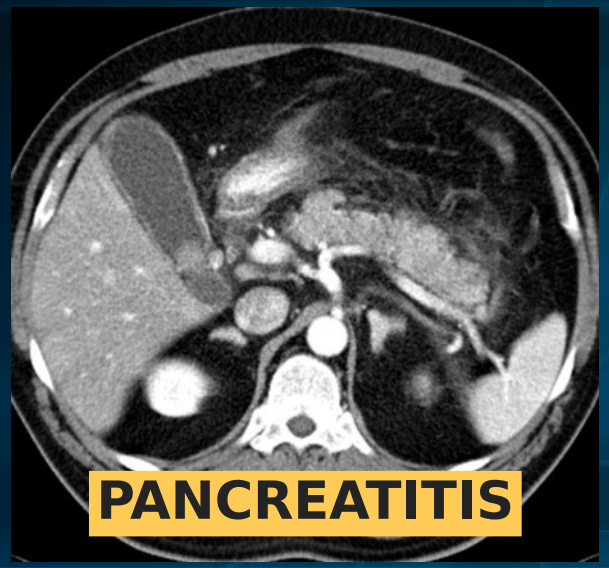


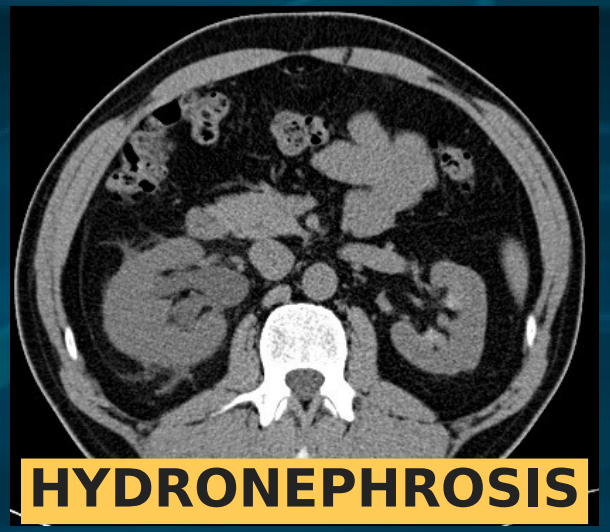
CT Concepts: Stranding



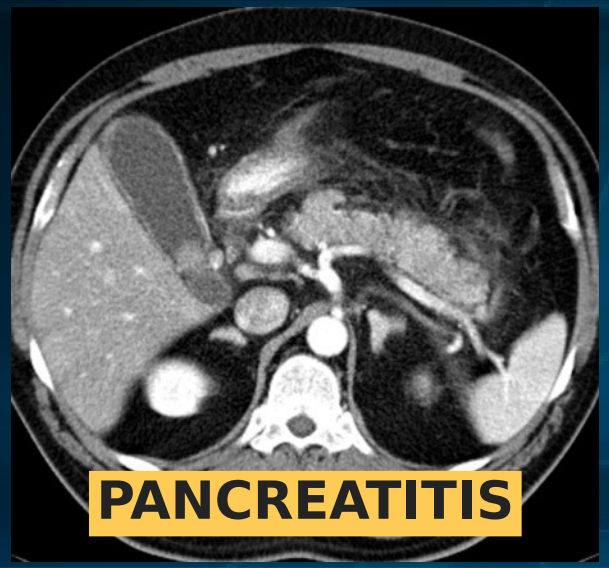


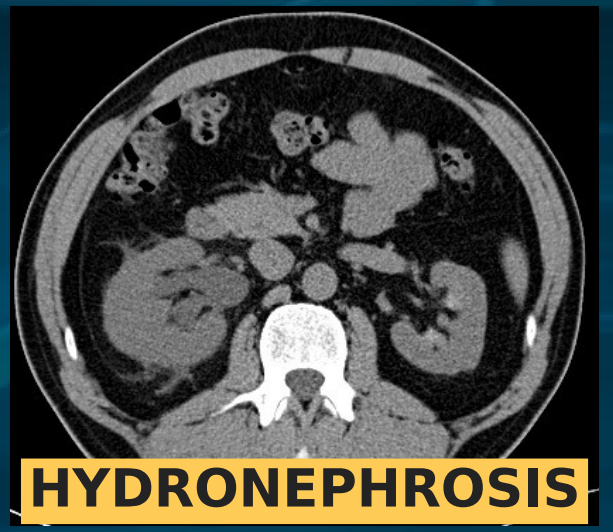
CT Concepts: Stranding

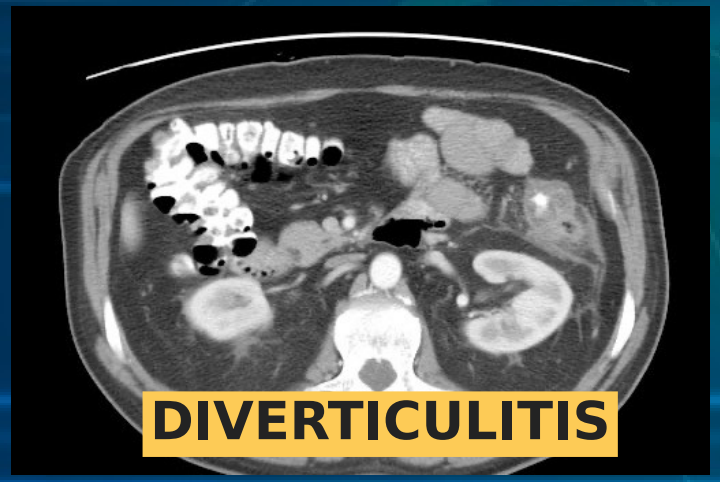




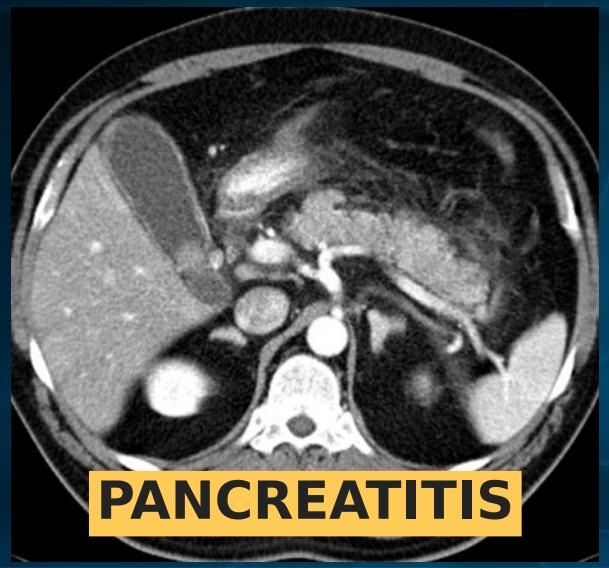
CT Concepts: Stranding

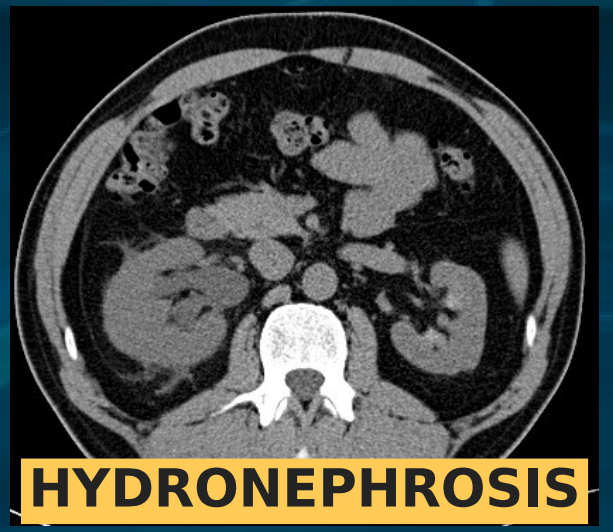


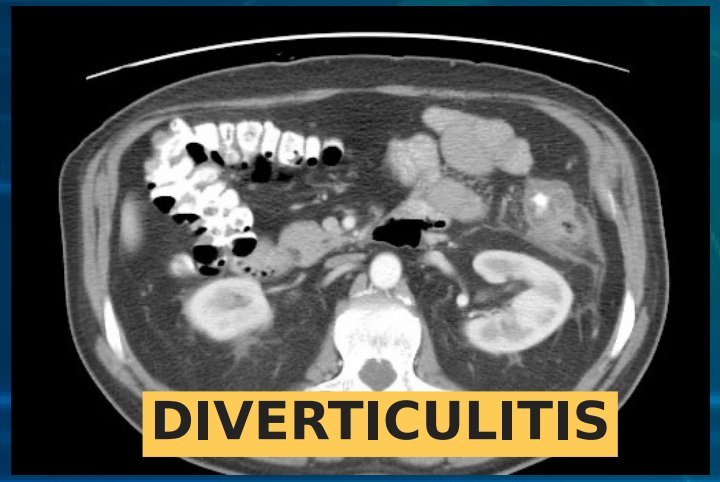




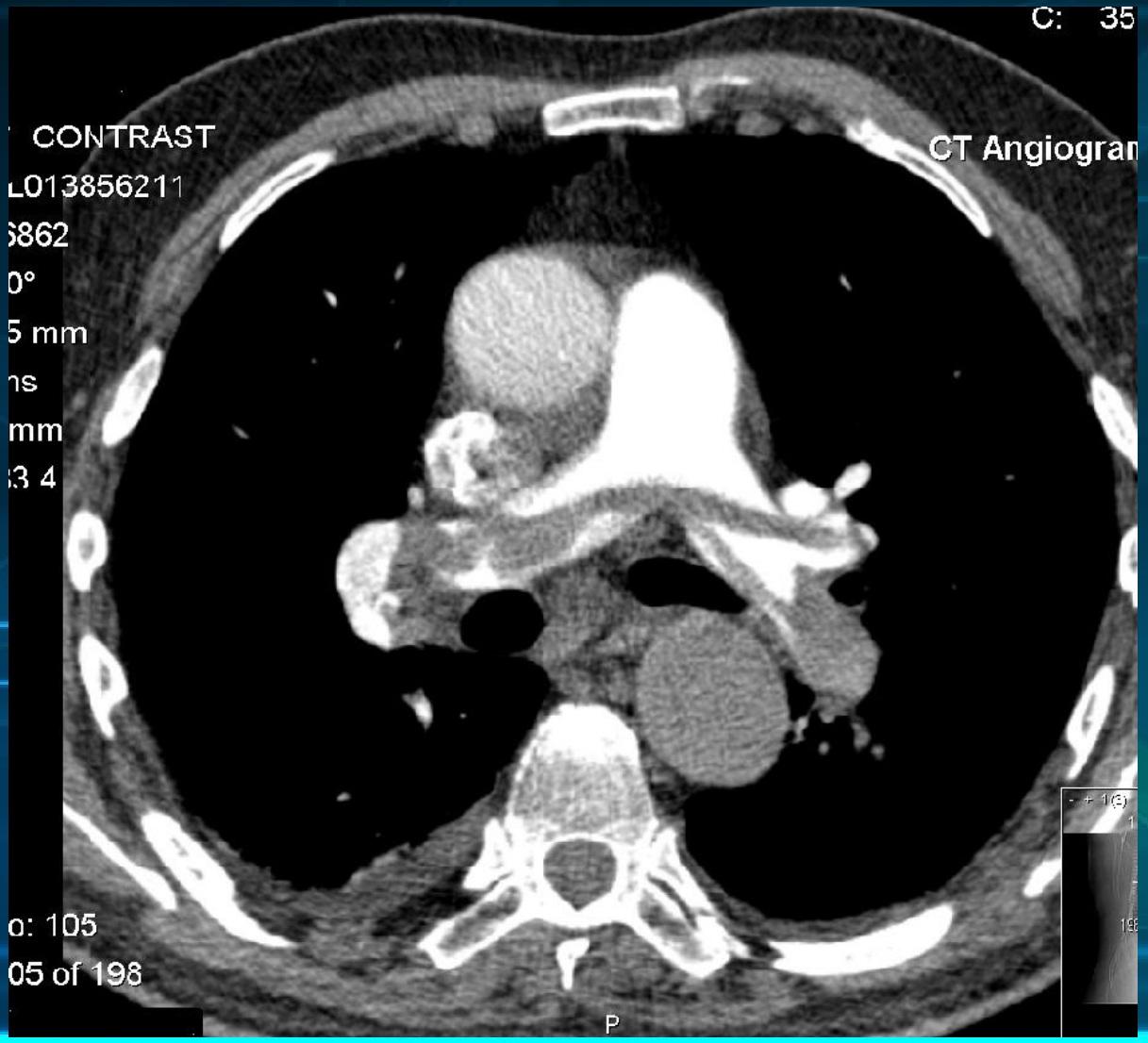
CT Concepts: Stranding



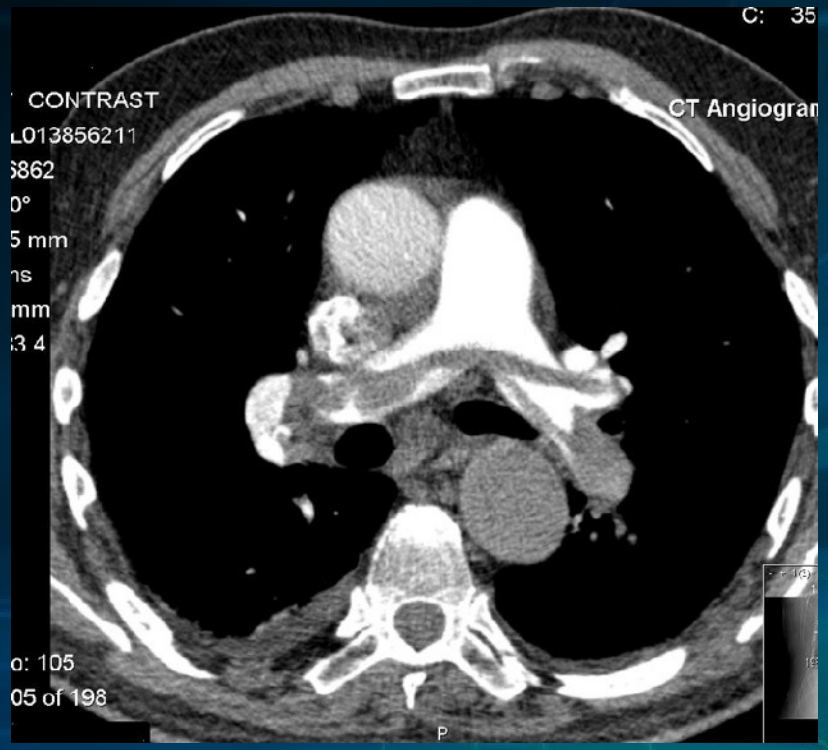




CT Concepts:

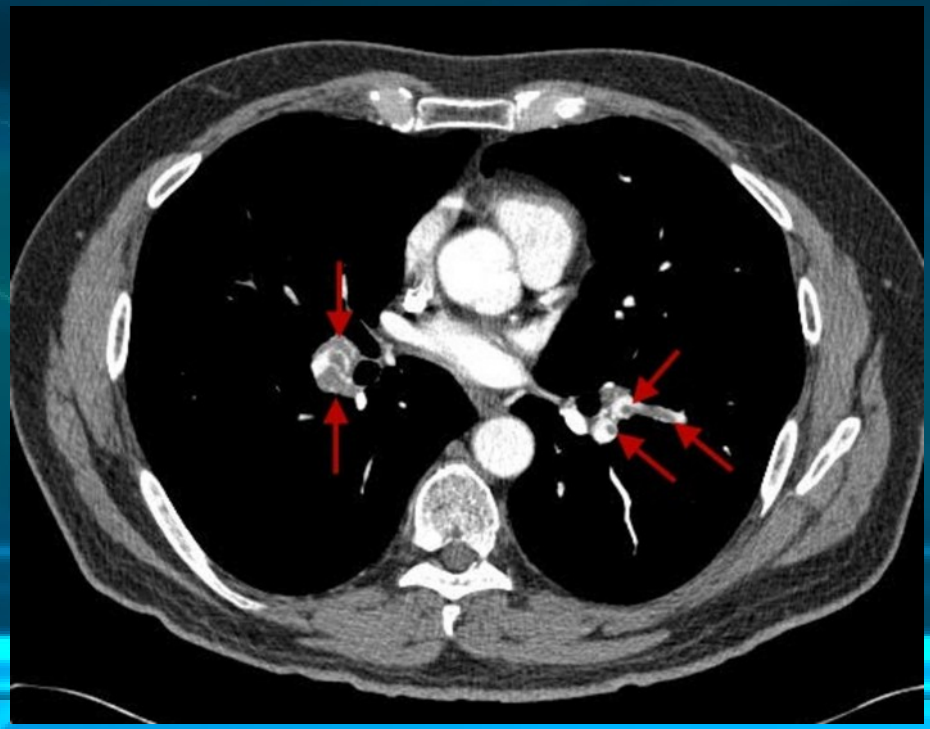

C: 35
CONTRAST
CT Angiogra
L013856211
862
0°
5 mm
ns
mm
3 4
o: 105
05 of 198
P

CT Concepts: Pulmonary embolism

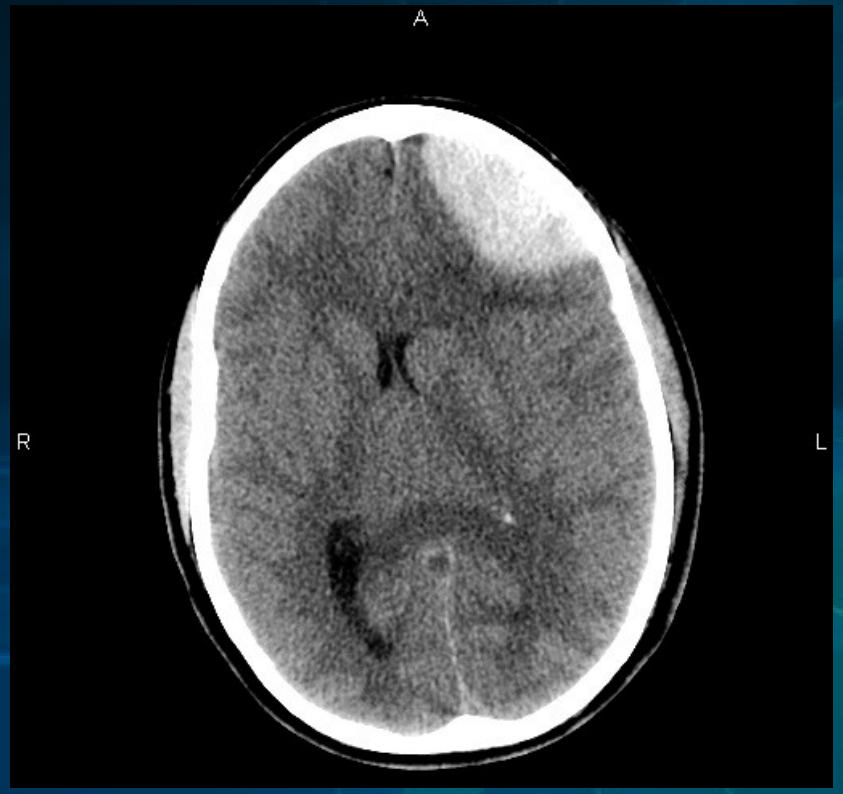


Pulmonary embolism

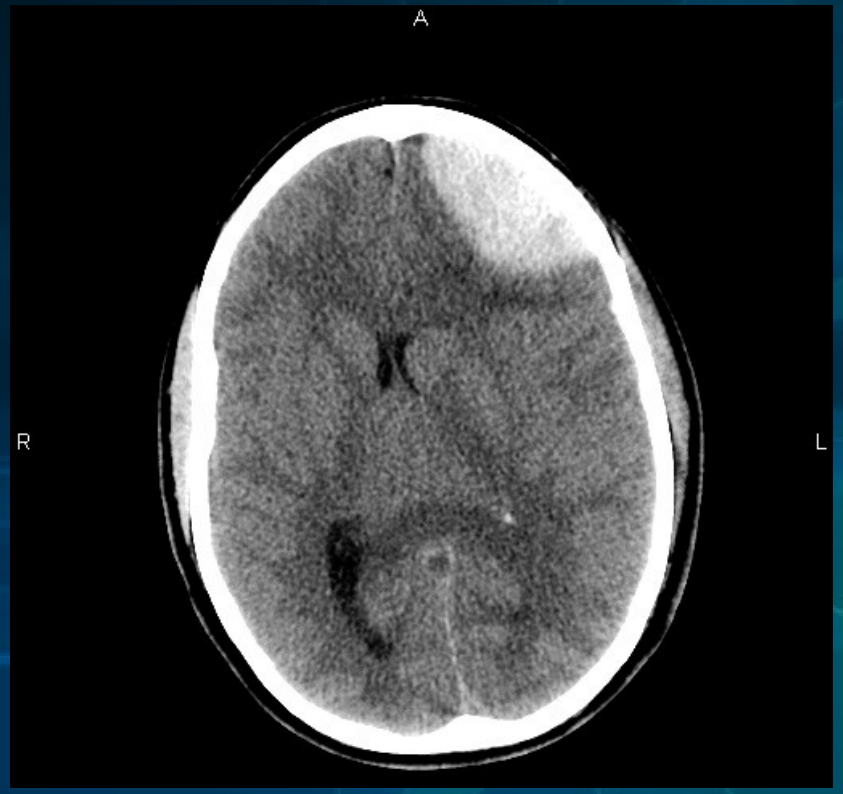
Central filling defects on CT pulmonary angiography



CT Concepts:



CT Concepts: Intracranial hemorrhage



Epidural hematoma
Lenticular shape

Subdural hematoma
Crescent shaped

MRI — Key Use Cases

Three scenarios where MRI is the preferred modality

Tissue Characterization

Indeterminate liver lesion on CT

Soft tissue mass characterization

Rectal/pelvic staging

Marrow: Infection and Neoplasm

Internal Derangement of Joints

Neurologic Imaging

Acute stroke (DWI)

Multiple sclerosis

Spinal cord pathology

Radiation Avoidance

Young patients

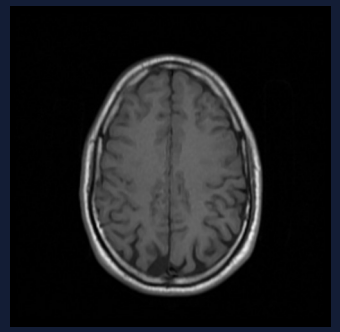
Pregnancy

Repeat surveillance imaging

MRI excels at soft tissue contrast without ionizing radiation — but longer scan times and contraindications (pacemakers, claustrophobia) limit use

MRI Sequences

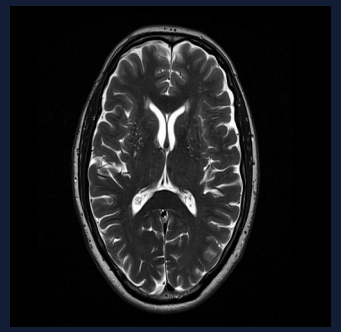
A 60-second primer



T1-Weighted

Fluid dark / Fat bright

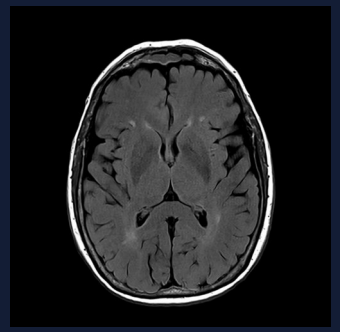
Anatomy, post-contrast enhancement



T2-Weighted

Fluid bright / Fat bright

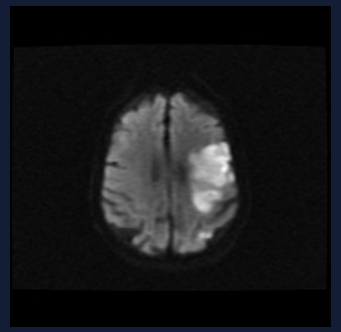
Pathology detection (edema, cysts)



FLAIR

Fluid suppressed / Lesions bright

Periventricular lesions, MS plaques



DWI

Restricted diffusion bright

Acute stroke, abscess

Mnemonic: T1 = anatomy | T2 = pathology | DWI = acute injury

MRCP vs. ERCP

Complementary, not interchangeable

MRCP
Diagnostic

- Noninvasive, no sedation
- Biliary & pancreatic duct anatomy

Diagnostic
→ Therapeutic

ERCP
Therapeutic

- Invasive, requires sedation
- Stone extraction, stent placement

Clinical pearl: MRCP first when intermediate probability of choledocholithiasis — may avoid an unnecessary invasive procedure

The Incidentaloma Problem

When radiology reports something you didn't ask about

40%

of CT scans reveal at least one incidental finding

Patient anxiety

Unexpected findings cause fear and uncertainty

Unnecessary cost

Cascading workups for benign findings

Medicolegal risk

Unfollowed incidentalomas = malpractice exposure

ACR Incidental Findings Committee white papers provide standardized follow-up recommendations for common incidentalomas

Incidental Findings

The big three for Internal Medicine

Adrenal Nodule

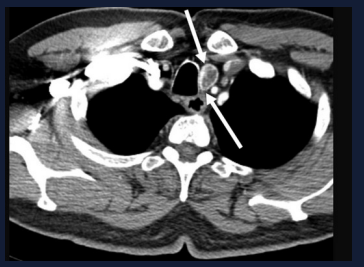
< 1 cm and low density (< 10 HU): benign adenoma — no follow-up

> 1 cm or indeterminate: adrenal washout CT or MRI | Refer endo if functional

Thyroid Nodule

Not characterizable by CT — ultrasound needed for TI-RADS scoring

Recommend US follow-up if ≥ 1 cm or suspicious morphology on CT



Lung Nodule

Fleischner Society guidelines: size + risk factors dictate follow-up interval

Sub-6 mm in low-risk patient: no routine follow-up needed

Always document incidental findings and recommended follow-up in your clinical note

Incidental Findings

The big

Adre

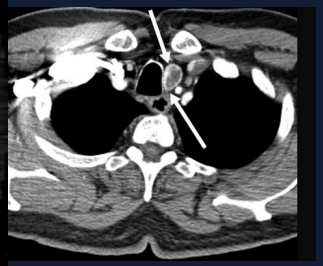
< 1 cm

> 1 cm

Thyro

Not char

Recomm



Lung

Fleischn

Sub-6 m

Always docu

Incidental Findings

The big three for Internal Medicine

Adre

< 1 cm

> 1 cm

Thyr

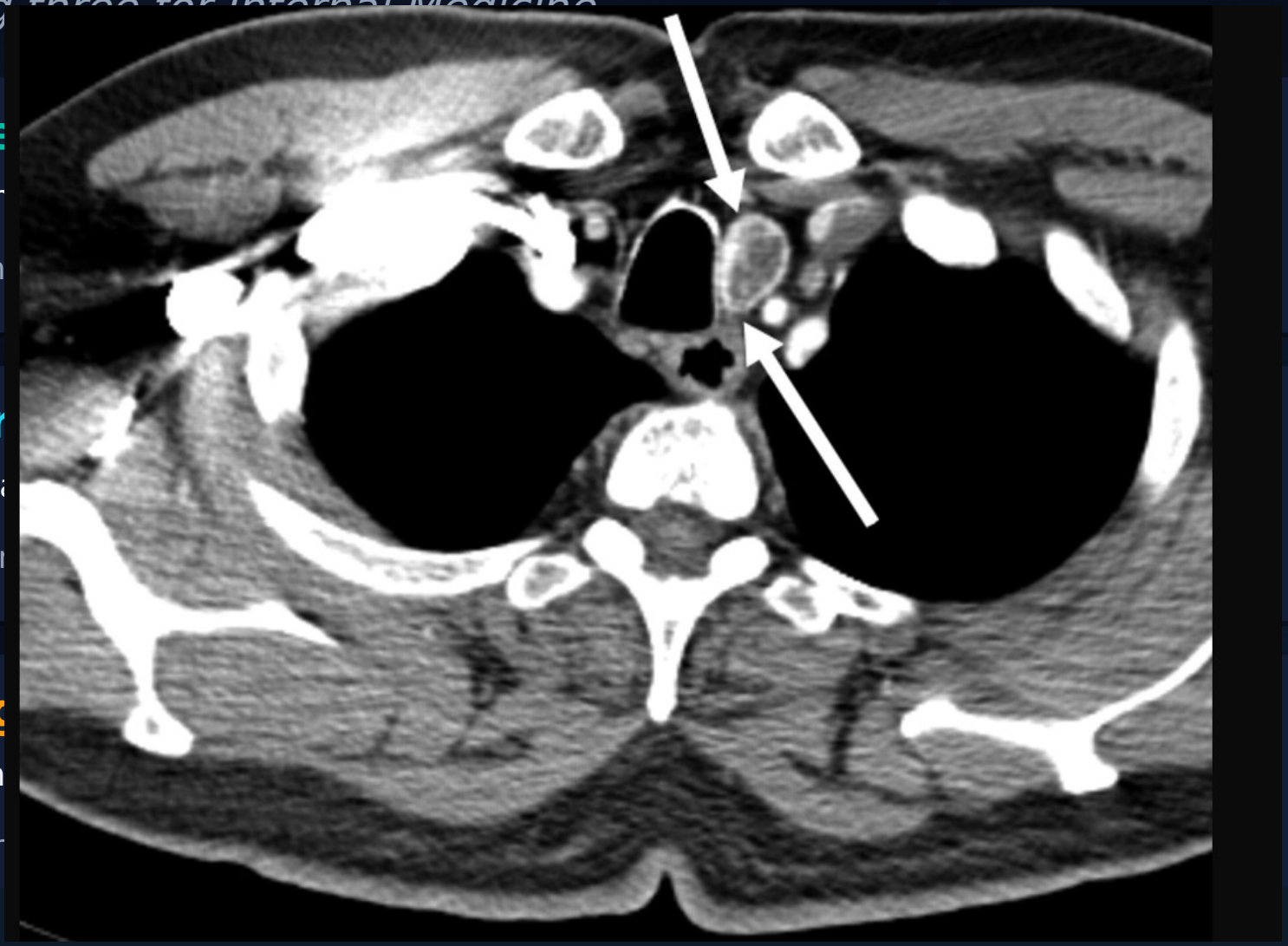
Not cha

Recomm

Lung

Fleisch

Sub-6 r



Always document incidental findings and recommended follow-up in your clinical note

Incidental Findings

The big three for Internal Medicine

Adrena

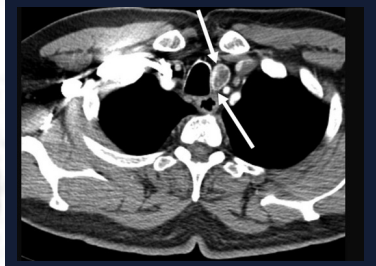
< 1 cm and

> 1 cm or i

Thyroid

Not charac

Recommend



Lung N

Fleischner

Sub-6 mm i

Always docume

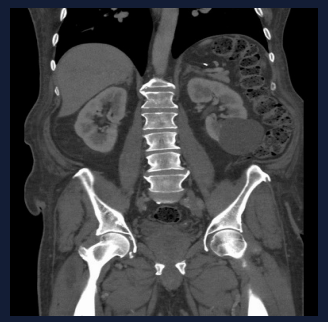
Incidental Renal & Liver Lesions

Triage by lesion type

Kidney

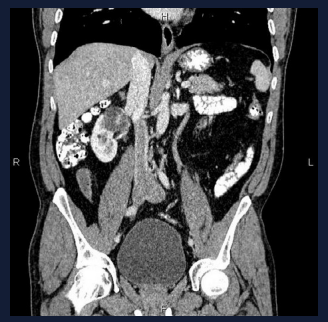
Simple Cyst (Bosniak I)

No enhancement, no septations
No follow-up needed



Complex Cyst (Bosniak II–IV)

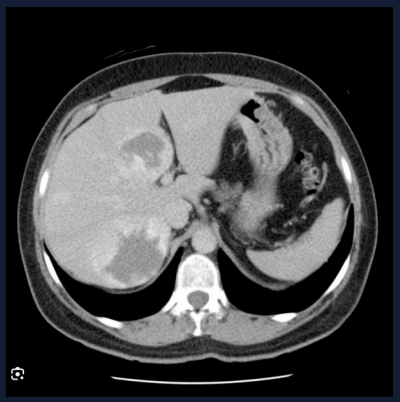
Septations, calcification, enhancement
Follow-up or urology referral



Liver

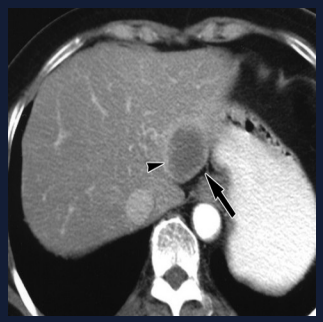
Simple Cyst / Hemangioma

Classic enhancement, benign
No follow-up if < 1 cm



Indeterminate Lesion

Incomplete characterization on CT
MRI with Eovist



Incidental Renal & Liver Lesions

Triage by lesion type

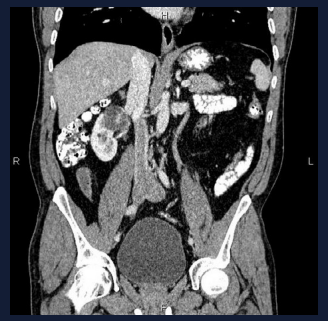
Kidney

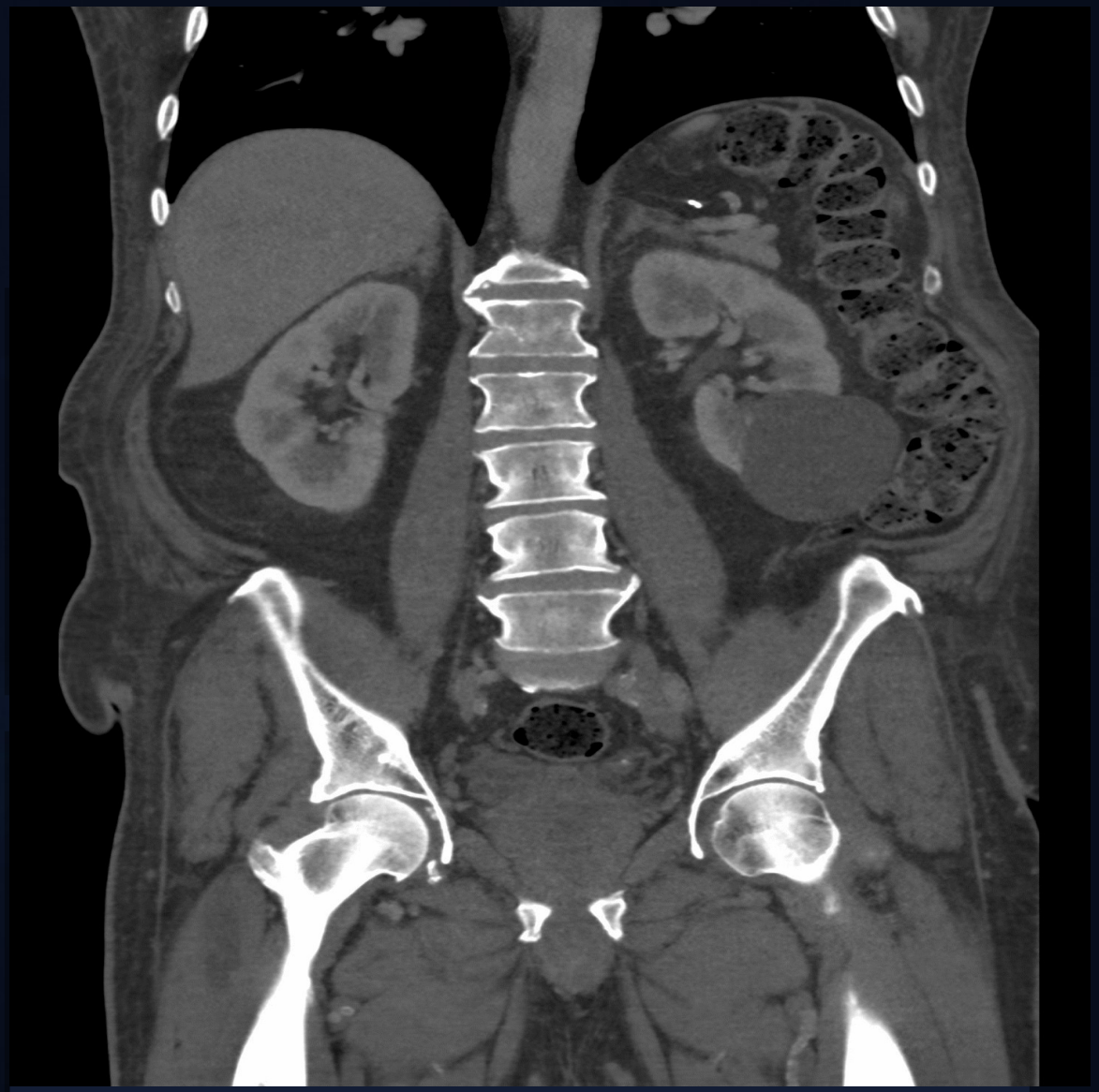
Simple Cyst (Bosniak I)

No enhancement, no septations
No follow-up needed

Complex Cyst (Bosniak II–IV)

Septations, calcification, enhancement
Follow-up or urology referral





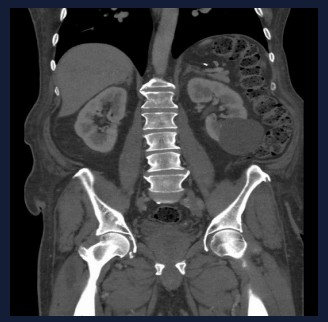
Incidental Renal & Liver Lesions

Triage by lesion type

Kidney

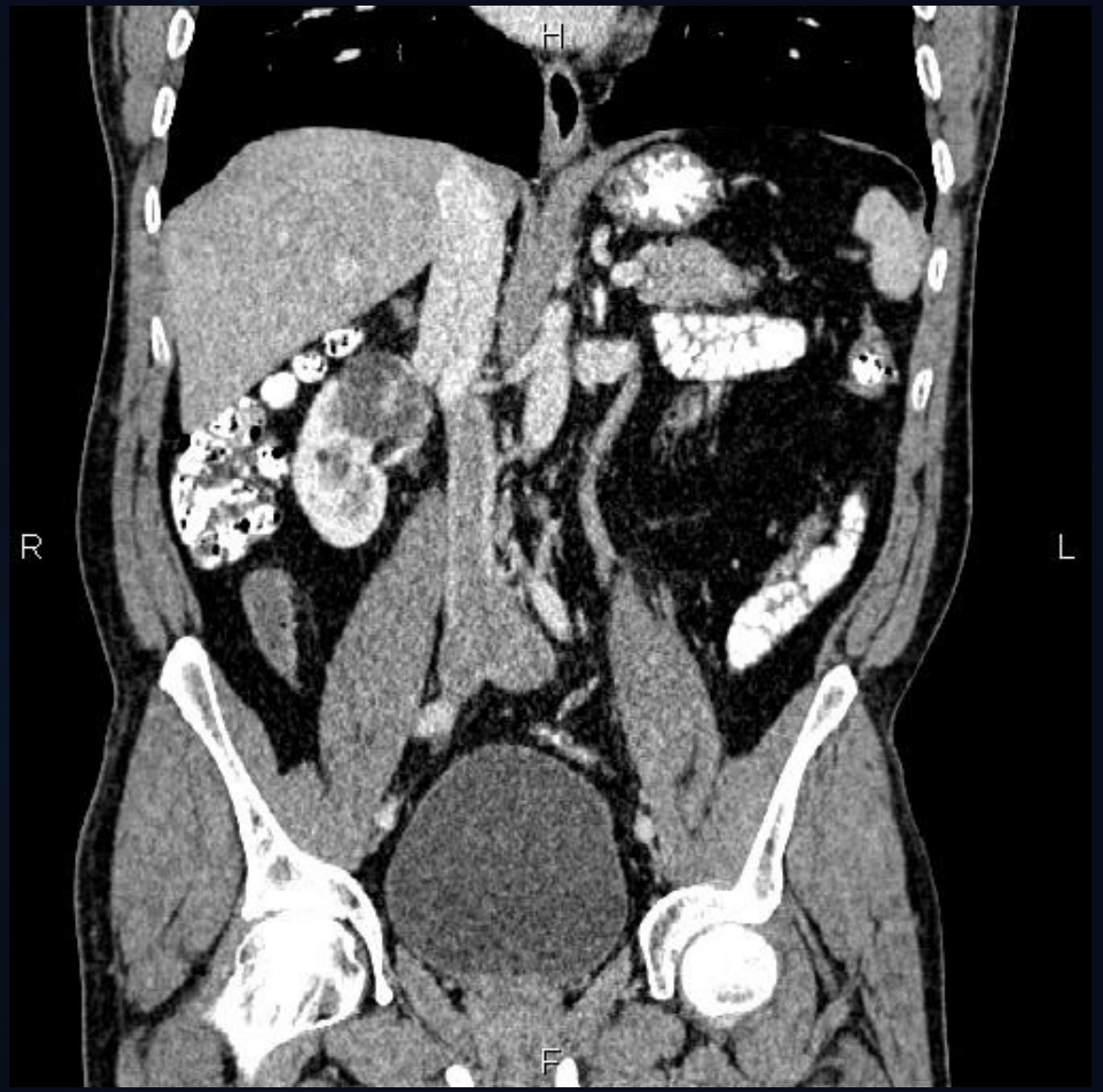
Simple Cyst (Bosniak I)

No enhancement, no septations
No follow-up needed

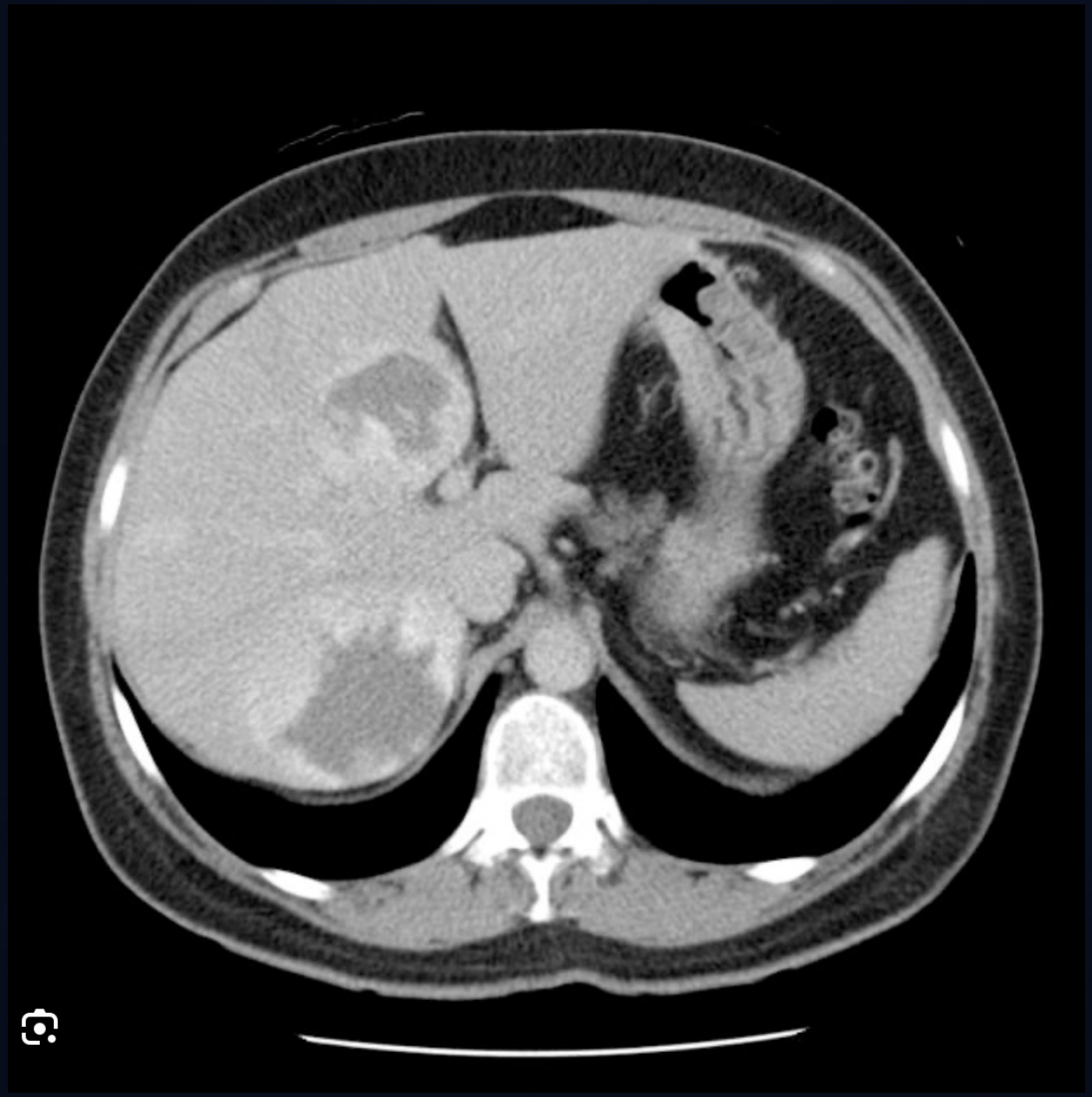


Complex Cyst (Bosniak II–IV)

Septations, calcification, enhancement
Follow-up or urology referral



Incidental Renal & Liver Lesions



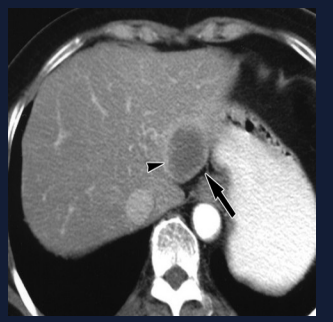
Liver

Simple Cyst / Hemangioma

Classic enhancement, benign
No follow-up if < 1 cm

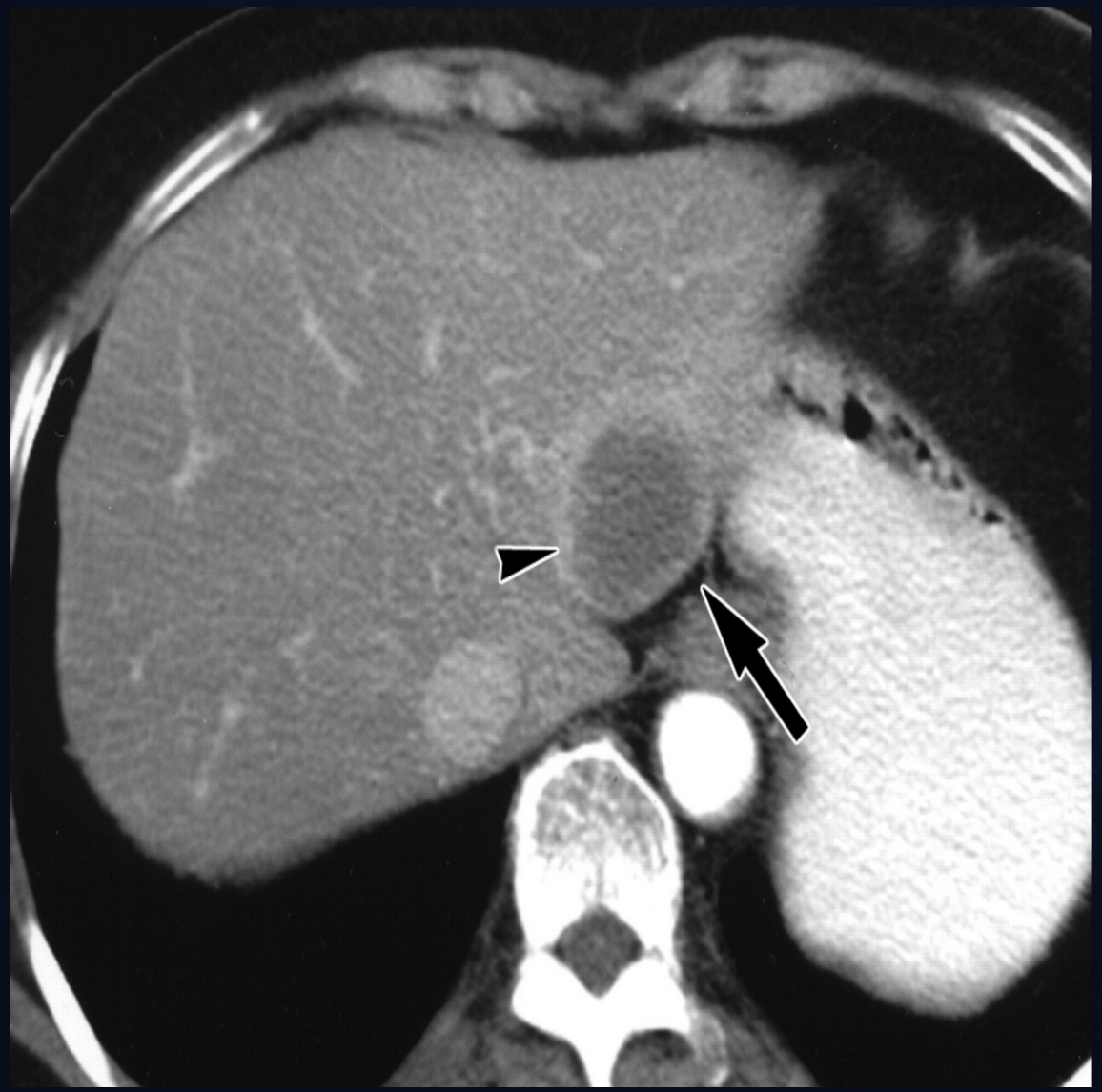
Indeterminate Lesion

Incomplete characterization on CT
MRI with Eovist



Incidental Renal & Liver Lesions

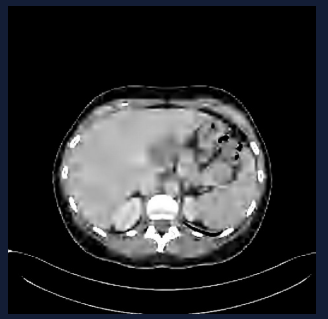
Triage by lesion type



Liver

Simple Cyst / Hemangioma

Classic enhancement, benign
No follow-up if < 1 cm

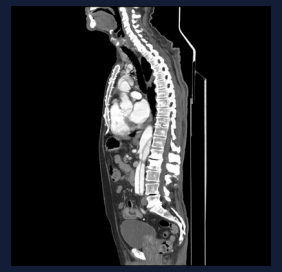


Indeterminate Lesion

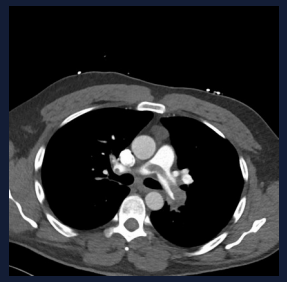
Incomplete characterization on CT
MRI with Eovist

Critical Findings

When Radiology calls you



Aortic Dissection



Saddle PE / RV Strain

Free Air (Perforation)

Large Intracranial Hemorrhage

Acute Bowel Ischemia

Tension Pneumothorax

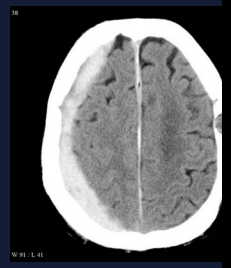
These findings require immediate clinician notification and may demand intervention before the final report is issued

Critic

When Radic

Aortic
Dissecti

ree Air
foration)



Large Intrac
Hemorrh

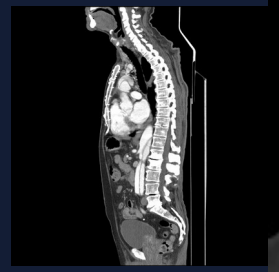
Pneumothorax

These findings re
report is issued

n before the final

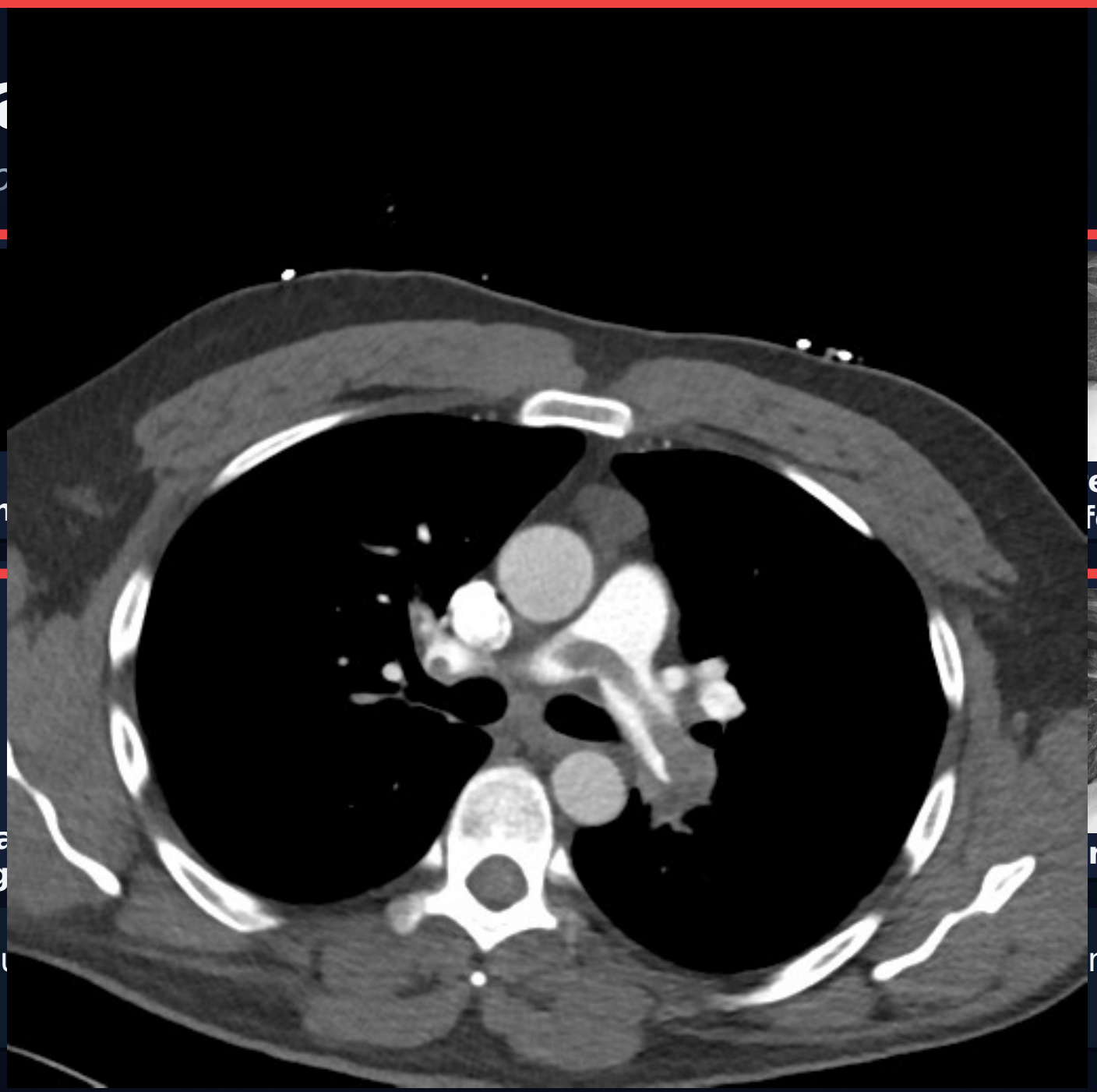
Critica

When Radiolo



Aortic Dissection

Large Intracra Hemorrhag



ee Air foration)

neumothorax

These findings requ n before the final report is issued

Critic

When Radio

Aortic
Dissecti

e Air
oration)

Large Intrac
Hemorrha

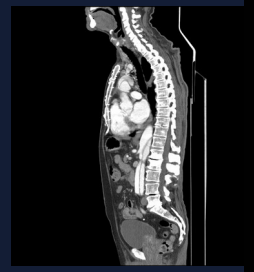
eumothorax

These findings re
report is issued

before the final

Critic

When Radiol



Aortic
Dissectio

ree Air
foration)

Large Intracr
Hemorrha

Pneumothorax

These findings rec
report is issued

on before the final

Critic

When Radiol

Aortic
Dissectio

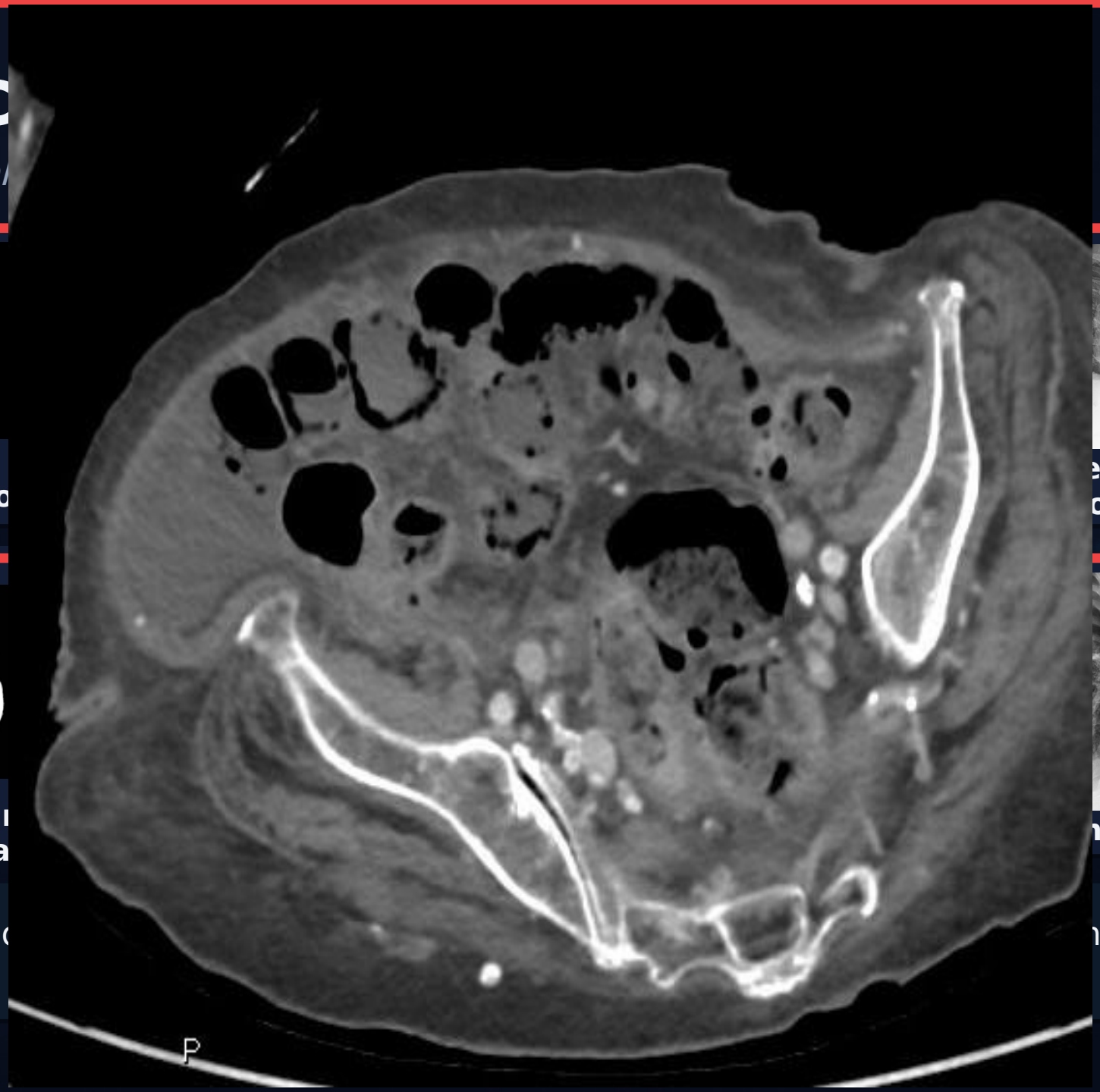
ee Air
oration)

Large Intracı
Hemorrha

neumothorax

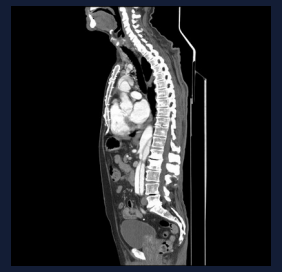
These findings rec
report is issued

n before the final



Critical

When Radiology



Aortic Dissection

ee Air oration)

Large Intracranial Hemorrhage

neumothorax

These findings require i

n before the final report is issued

The Clinical History That Changes the Read

Your order shapes the interpretation

Vague Order

CT Abdomen/Pelvis w/ contrast

Clinical history:
"Abdominal pain"

Targeted Order

CT Abdomen/Pelvis w/ contrast

Clinical history:
"RLQ pain, WBC 15k, fever. Concern for appendicitis"

Orders should include a SYMPTOM or MECHANISM OF INJURY, and if possible, a SUSPECTED DIAGNOSIS.

Orders with only a "rule-out" diagnosis are less useful and NOT BILLABLE.

Up to 50% of radiologist interpretations are influenced by the clinical history provided on the order

When to Call the Radiologist

We're consultants, not lab machines

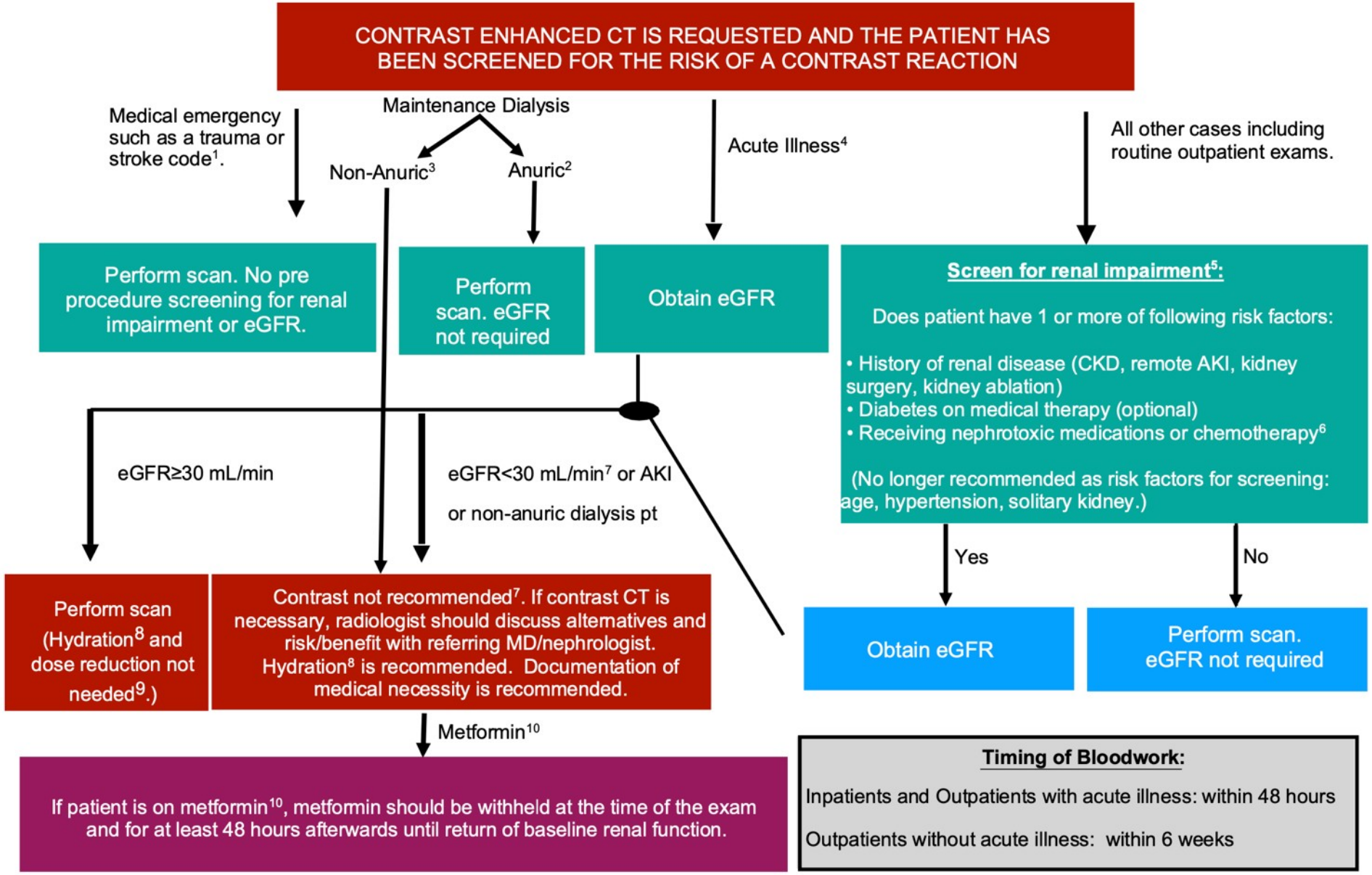
- Imaging findings don't match the clinical picture
- Need urgent interpretation beyond a stat order
- Unsure which modality to order
- IR consultation: drainage, biopsy, embolization

> *A two-minute phone call can save your patient hours of unnecessary workup — or catch a critical finding before it's too late.*

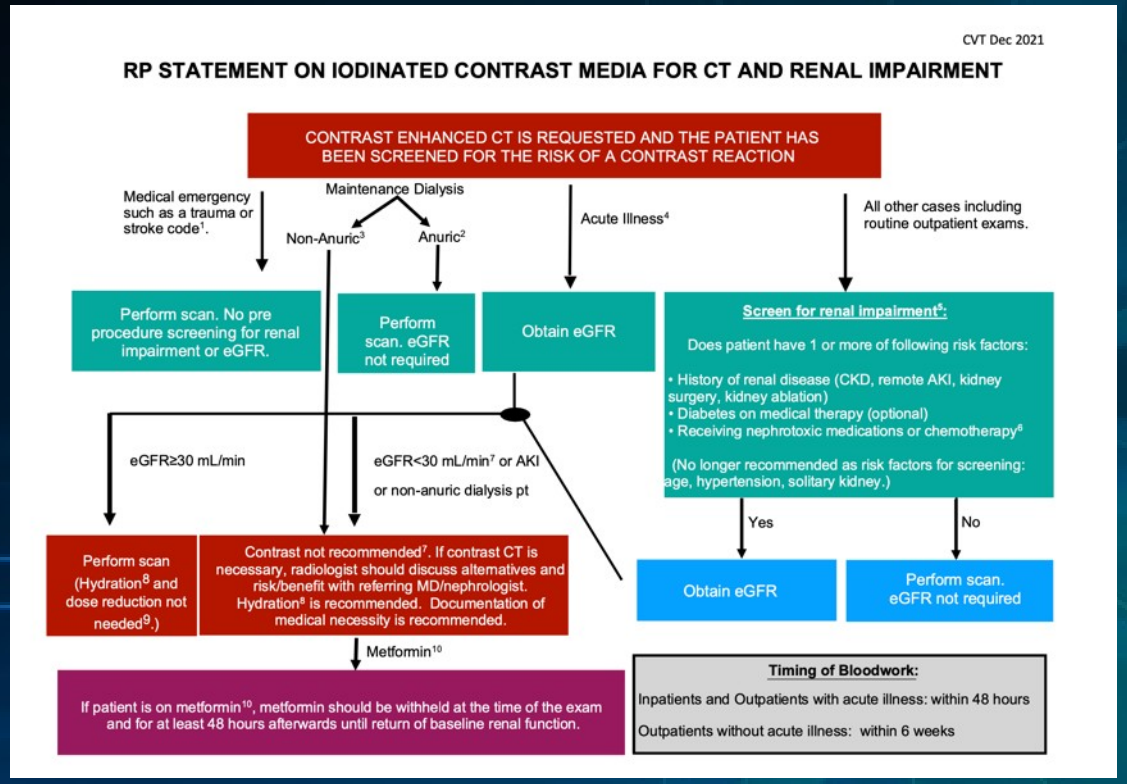
The best imaging is the study you discuss with the radiologist before ordering.

CONTRAST SAFETY

Contrast and Renal Failure


CONTRAST ENHANCED CT IS REQUESTED AND THE PATIENT HAS BEEN SCREENED FOR THE RISK OF A CONTRAST REACTION
Medical emergency such as a trauma or stroke code[1].
Maintenance Dialysis
Non-Anuric[3]
Anuric[2]
Acute Illness[4]
All other cases including routine outpatient exams.
Perform scan. No pre procedure screening for renal impairment or eGFR.
Perform scan. eGFR not required
Obtain eGFR
Screen for renal impairment[5]:
Does patient have 1 or more of following risk factors:
• History of renal disease (CKD, remote AKI, kidney surgery, kidney ablation)
• Diabetes on medical therapy (optional)
• Receiving nephrotoxic medications or chemotherapy[6]
(No longer recommended as risk factors for screening: age, hypertension, solitary kidney.)
eGFR≥30 mL/min
eGFR<30 mL/min[7] or AKI
or non-anuric dialysis pt
Yes
No
Perform scan (Hydration[8] and dose reduction not needed[9].)
Contrast not recommended[7]. If contrast CT is necessary, radiologist should discuss alternatives and risk/benefit with referring MD/nephrologist. Hydration[8] is recommended. Documentation of medical necessity is recommended.
Obtain eGFR
Perform scan. eGFR not required
Metformin[10]
If patient is on metformin[10], metformin should be withheld at the time of the exam and for at least 48 hours afterwards until return of baseline renal function.
Timing of Bloodwork:
Inpatients and Outpatients with acute illness: within 48 hours
Outpatients without acute illness: within 6 weeks

Key points


CVT Dec 2021
RP STATEMENT ON IODINATED CONTRAST MEDIA FOR CT AND RENAL IMPAIRMENT
CONTRAST ENHANCED CT IS REQUESTED AND THE PATIENT HAS BEEN SCREENED FOR THE RISK OF A CONTRAST REACTION
Medical emergency such as a trauma or stroke code[1].
Maintenance Dialysis
Non-Anuric[3]
Anuric[2]
Acute Illness[4]
All other cases including routine outpatient exams.
Perform scan. No pre procedure screening for renal impairment or eGFR.
Perform scan. eGFR not required
Obtain eGFR
Screen for renal impairment[5]:
Does patient have 1 or more of following risk factors:
• History of renal disease (CKD, remote AKI, kidney surgery, kidney ablation)
• Diabetes on medical therapy (optional)
• Receiving nephrotoxic medications or chemotherapy[6]
(No longer recommended as risk factors for screening: age, hypertension, solitary kidney.)
eGFR≥30 mL/min
eGFR<30 mL/min[7] or AKI or non-anuric dialysis pt
Yes
No
Perform scan (Hydration[8] and dose reduction not needed[9].)
Contrast not recommended[7]. If contrast CT is necessary, radiologist should discuss alternatives and risk/benefit with referring MD/nephrologist. Hydration[8] is recommended. Documentation of medical necessity is recommended.
Obtain eGFR
Perform scan. eGFR not required
Metformin[10]
If patient is on metformin[10], metformin should be withheld at the time of the exam and for at least 48 hours afterwards until return of baseline renal function.
Timing of Bloodwork:
Inpatients and Outpatients with acute illness: within 48 hours
Outpatients without acute illness: within 6 weeks

GFR threshold of 30 for CT IV contrast

Anuric dialysis patients can receive CT IV contrast

Non-anuric dialysis patients should not receive CT IV contrast

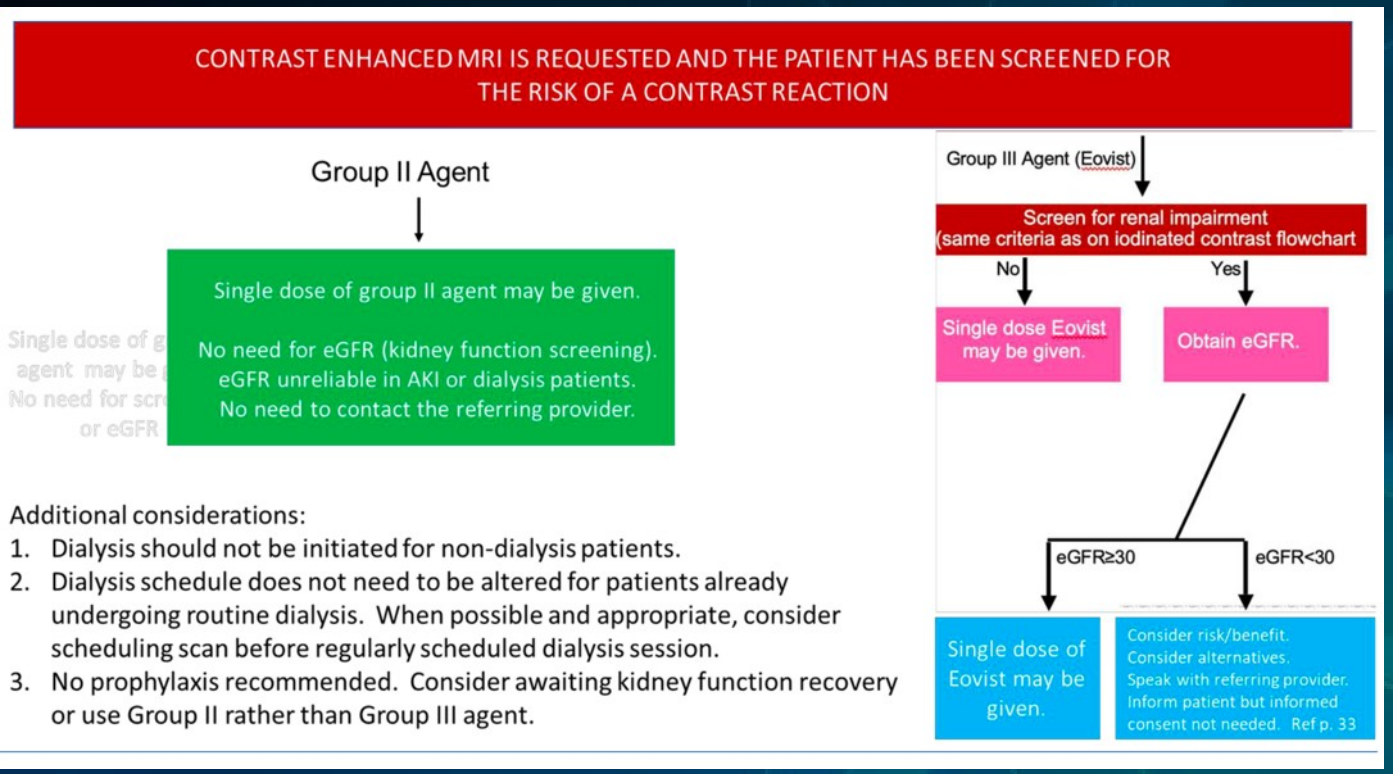
Outpatients without renal disease, diabetes or nephrotoxic meds do not require routine renal function screening prior to CT IV contrast

To prevent contrast associated nephropathy in susceptible patients, hydration is the preferred intervention

What about MRI contrast?

- Gadolinium does not cause contrast-induced nephropathy
- In patients with pre-existing renal insufficiency, or acute renal failure, gadolinium can cause Nephrogenic Systemic Fibrosis (NSF)

What about MRI contrast?


CONTRAST ENHANCED MRI IS REQUESTED AND THE PATIENT HAS BEEN SCREENED FOR THE RISK OF A CONTRAST REACTION
Group II Agent
Single dose of group II agent may be given.
No need for eGFR (kidney function screening).
eGFR unreliable in AKI or dialysis patients.
No need to contact the referring provider.
Additional considerations:
1. Dialysis should not be initiated for non-dialysis patients.
2. Dialysis schedule does not need to be altered for patients already undergoing routine dialysis. When possible and appropriate, consider scheduling scan before regularly scheduled dialysis session.
3. No prophylaxis recommended. Consider awaiting kidney function recovery or use Group II rather than Group III agent.
Group III Agent (Eovist)
Screen for renal impairment (same criteria as on iodinated contrast flowchart
No
Yes
Single dose Eovist may be given.
Obtain eGFR.
eGFR≥30
eGFR<30
Single dose of Eovist may be given.
Consider risk/benefit.
Consider alternatives.
Speak with referring provider.
Inform patient but informed consent not needed. Ref p. 33

Key points

Modern Group II contrast agents can be given without routine renal function screening

Group III agents (e.g. Eovist for certain liver diagnoses) require renal function screening, with a suggested GFR threshold of 30

ntrast Reactions

Mild

Allergic-like	Physiologic
Limited urticaria / pruritis	Limited nausea / vomiting limited
Cutaneous Edema	Transient flushing / warmth / chills
Limited “itchy”/“scratchy” throat	Headache / dizziness / anxiety / altered taste
Nasal congestion	Mild hypertension
Sneezing / conjunctivitis / rhinorrhea	Vasovagal reaction that resolves spontaneously

Moderate

Allergic-like	Physiologic
Diffuse urticaria / pruritis	Protracted nausea / vomiting
Diffuse erythema, stable vital signs	Hypertensive urgency
Facial edema without dyspnea	Isolated chest pain
Throat tightness or hoarseness without dyspnea	Vasovagal reaction that requires and is responsive to treatment
Wheezing / bronchospasm, mild or no hypoxia	

Severe

Allergic-like	Physiologic
Diffuse edema, or facial edema with dyspnea	Vasovagal reaction resistant to treatment
Diffuse erythema with hypotension	Arrhythmia
Laryngeal edema with stridor and/or hypoxia	Convulsions, seizures
Wheezing / bronchospasm, significant hypoxia	Hypertensive emergency
Anaphylactic shock (hypotension + tachycardia)	

Prior Contrast Reaction?

Determining the need for prophylaxis

MILD

No premedication

Switch contrast agent
when inciting agent is known

MODERATE

Switch contrast agent
when feasible

Premedication may be considered
shared decision-making

SEVERE

Consider alternative imaging first

If contrast required:
Switch agent + Premedicate

Hospital setting with rapid response team available

Key paradigm shift: Switching the contrast agent is now preferred over premedication at all severity levels. Premedication alone (without switching) is not effective when the same agent is re-used.

Wang et al. Radiology 2025; 315(2) — ACR / AAAAI Consensus

Prophylaxis Not Required

Common scenarios that do not warrant premedication

These histories alone ≠ premedication

- Shellfish or iodine allergy
- Isolated history of asthma
- Drug, food, or insect sting allergy
- Prior reaction to gadolinium (for ICM)
- Non-immune / physiologic reaction
- Isolated history of delayed ICM reaction

Why this matters

Iodine is not an allergen

No pathophysiologic link between shellfish allergy and ICM hypersensitivity. The myth persists from an era of high-osmolality agents.

Unnecessary premedication harms

Corticosteroid side effects (hyperglycemia, infection risk), diagnostic delay, anticholinergic burden from diphenhydramine, and prolonged hospital stay.

~48% of breakthrough reactions are moderate or severe — premedication does not eliminate risk

Wang et al. Radiology 2025; 315(2) — ACR / AAAAI Consensus

rast Reactions: Prevention

Contrast Premedication for Allergy

- Two frequently used regimens are:
  - 1. Oral
    - 50 mg prednisone by mouth at 13 hours, 7 hours, and 1 hour before contrast media injection, plus
    - Diphenhydramine (Benadryl®) – 50 mg intravenously, intramuscularly, or by mouth 1 hour before contrast medium [12].
  - 2. Intravenous “stat” prep -- not preferred
    - IV methylprednisolone, benadryl – check with institution for exact protocol timing

rast Reactions: Treatment

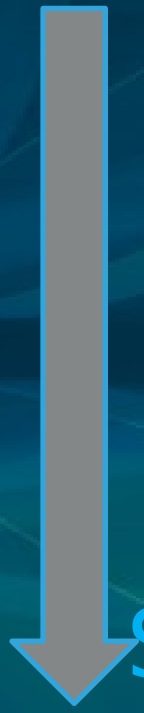
Mild

Observation

Benadryl

Epinepherine (IM)

Epinepherine (IV)



Severe

CASES

A 54-year-old male with a history of prior abdominal surgery presents with sudden onset of diffuse, crampy abdominal pain, nausea, and multiple episodes of vomiting. On examination, he has abdominal distention and hyperactive bowel sounds.

First imaging test?

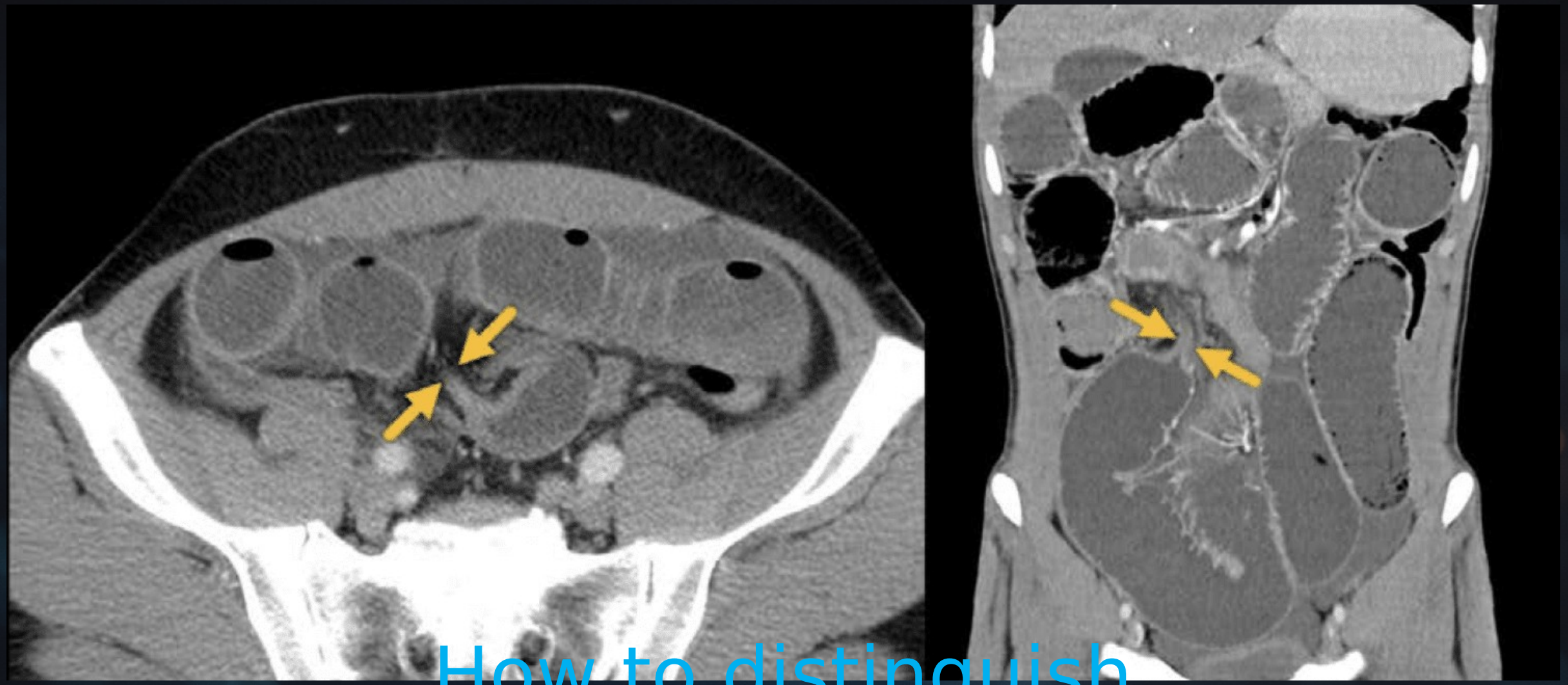
American College of Radiology
ACR Appropriateness Criteria®
Suspected Small-Bowel Obstruction

Variant 1: **Suspected small-bowel obstruction. Acute presentation. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT abdomen and pelvis with IV contrast	Usually Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	May Be Appropriate	☢☢☢
MRI abdomen and pelvis without and with IV contrast	May Be Appropriate	O
Radiography abdomen and pelvis	May Be Appropriate (Disagreement)	☢☢☢
Fluoroscopy small bowel follow-through	May Be Appropriate	☢☢☢
MRI abdomen and pelvis without IV contrast	May Be Appropriate	O
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT enteroclysis	Usually Not Appropriate	☢☢☢☢
CT enterography	Usually Not Appropriate	☢☢☢☢
MR enterography	Usually Not Appropriate	O
US abdomen and pelvis	Usually Not Appropriate	O
Fluoroscopy small bowel enteroclysis	Usually Not Appropriate	☢☢☢
MR enteroclysis	Usually Not Appropriate	O

Diagnosis?

Next imaging test?



How to distinguish complete from partial obstruction?

Small Bowel Series

Usually with water-soluble contrast (Gastrografin)

Serial imaging for up to 24h

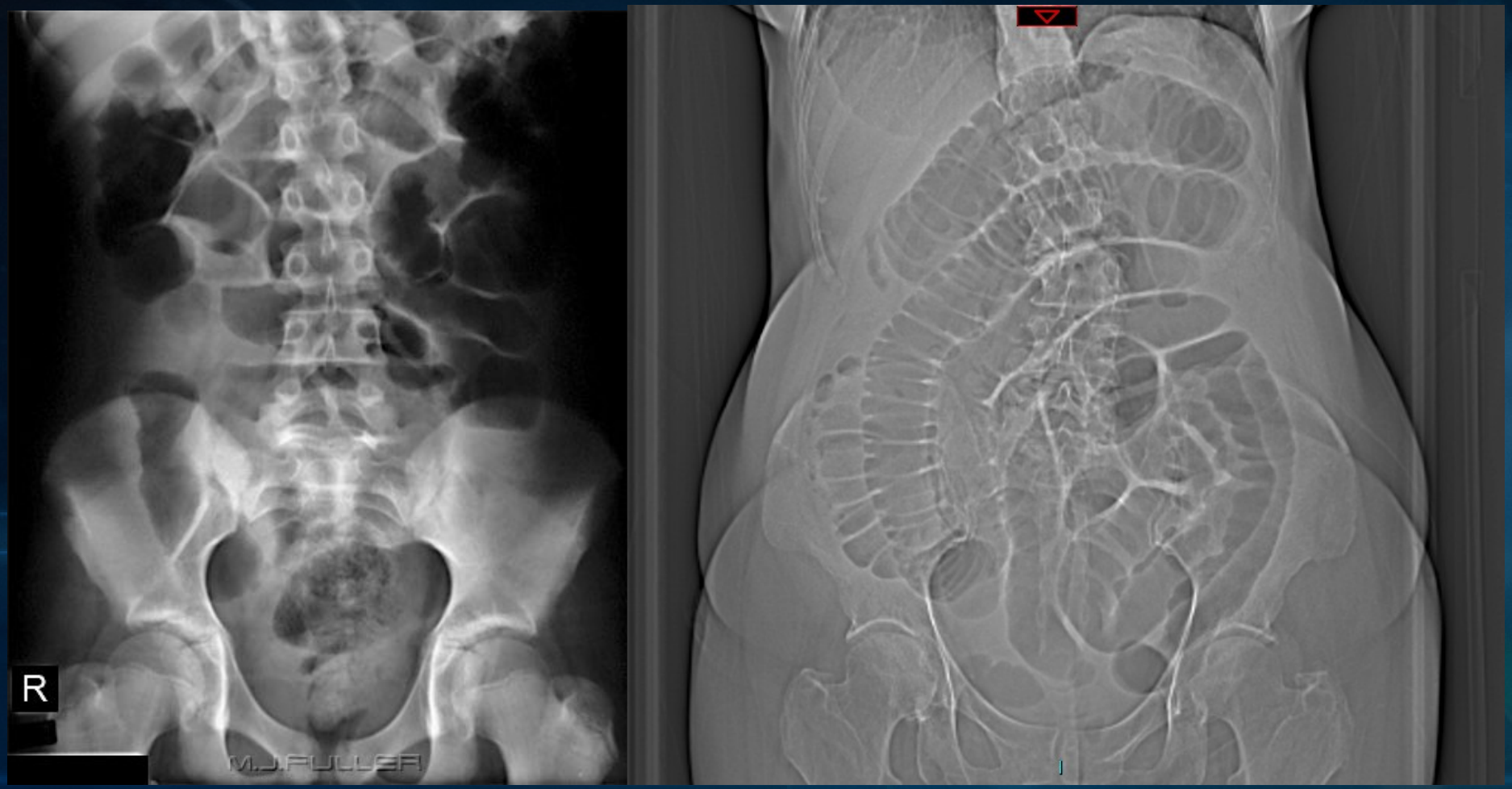
Equivocal evidence that it can provide therapeutic effect

Distinguishing Small and Large Bowel

What are the folds called in the small bowel?

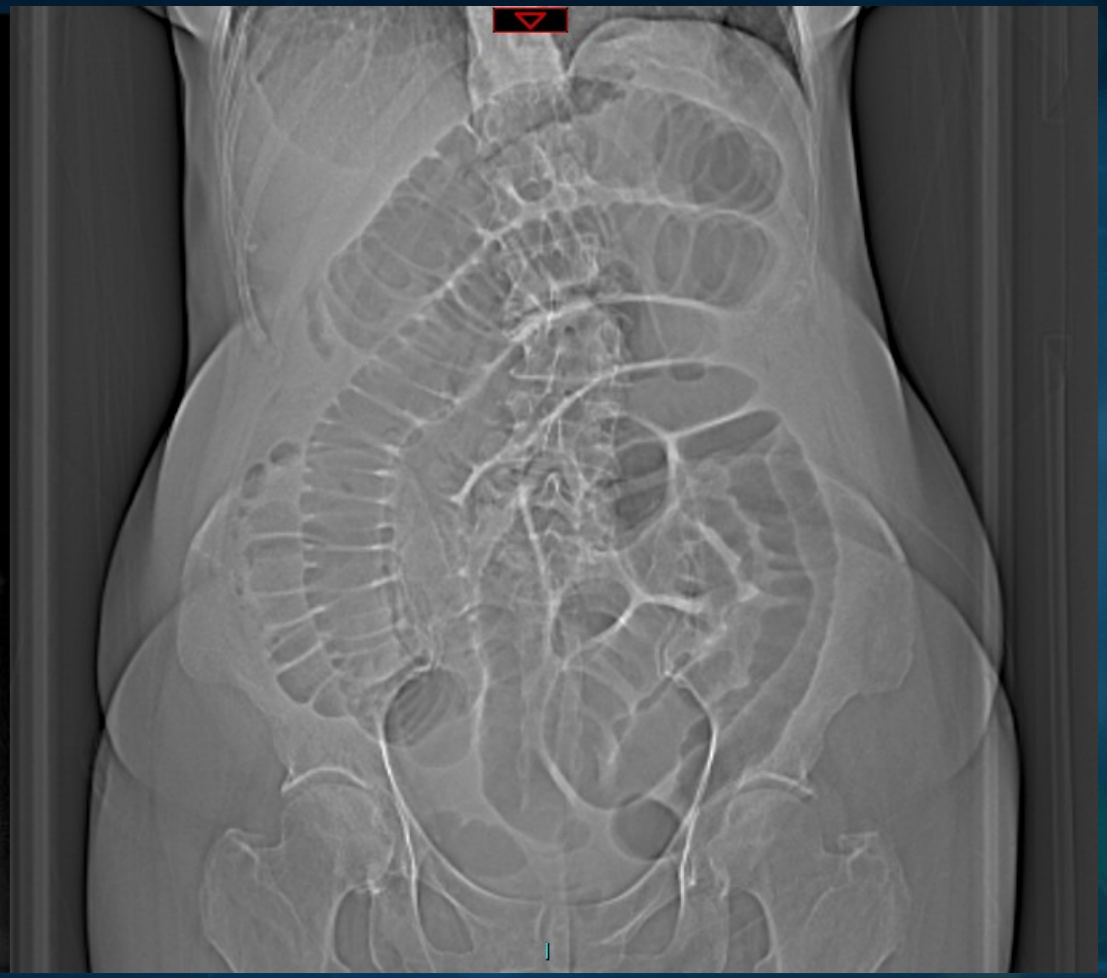
What are the folds called in the large bowel?

Abdominal Radiography: Bowel gas patterns



One of these is a small bowel obstruction

Abdominal Radiography: Bowel gas patterns



One of these is a small bowel obstruction

Ileus

SBO

A 45-year-old woman presents with sudden onset of severe, right-sided flank pain that radiates to the groin. She describes the pain as sharp and intermittent. She also reports nausea and has had one episode of vomiting. On examination, she is afebrile with normal vital signs, but there is tenderness over the right costovertebral angle.

You are rounding with a POCUS machine. What imaging might you perform?

M
R LONG
0
5
10
15

L

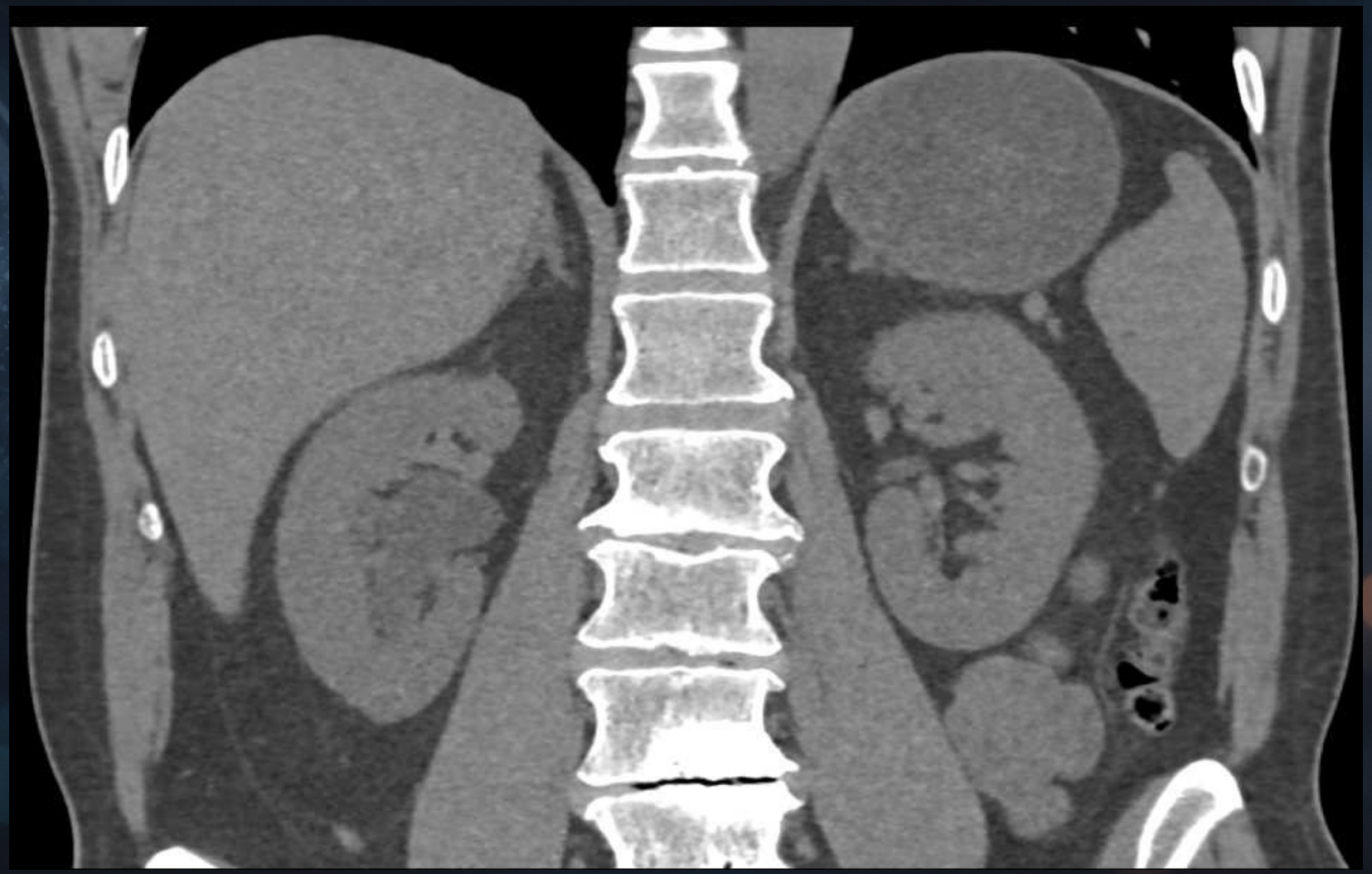
A 45-year-old woman presents with sudden onset of severe, right-sided flank pain that radiates to the groin. She describes the pain as sharp and intermittent. She also reports nausea and has had one episode of vomiting. On examination, she is afebrile with normal vital signs, but there is tenderness over the right costovertebral angle.

What is the best imaging test to order?

American College of Radiology
ACR Appropriateness Criteria®
Acute Onset Flank Pain-Suspicion of Stone Disease (Urolithiasis)

Variant 1: **Acute onset flank pain. Suspicion of stone disease. No history or remote history of stone disease. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT abdomen and pelvis without IV contrast	Usually Appropriate	☢☢☢
US color Doppler kidneys and bladder retroperitoneal	May Be Appropriate (Disagreement)	O
US kidneys and bladder retroperitoneal	May Be Appropriate (Disagreement)	O
Radiography abdomen and pelvis	May Be Appropriate	☢☢
Radiography intravenous urography	Usually Not Appropriate	☢☢☢
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRU without and with IV contrast	Usually Not Appropriate	O
MRU without IV contrast	Usually Not Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CTU without and with IV contrast	Usually Not Appropriate	☢☢☢☢



Why is this patient prone?

A 45-year-old woman presents with sudden onset of severe, right-sided flank pain that radiates to the groin. She describes the pain as sharp and intermittent. She also reports nausea and has had one episode of vomiting. On examination, she is afebrile with normal vital signs, but there is tenderness over the right costovertebral angle.

What if CT shows no obstructing stone to explain the hydronephrosis?

Variant 4: **Acute onset flank pain. Suspicion of stone disease. CT without contrast is inconclusive for the presence of stones. Next imaging study.**

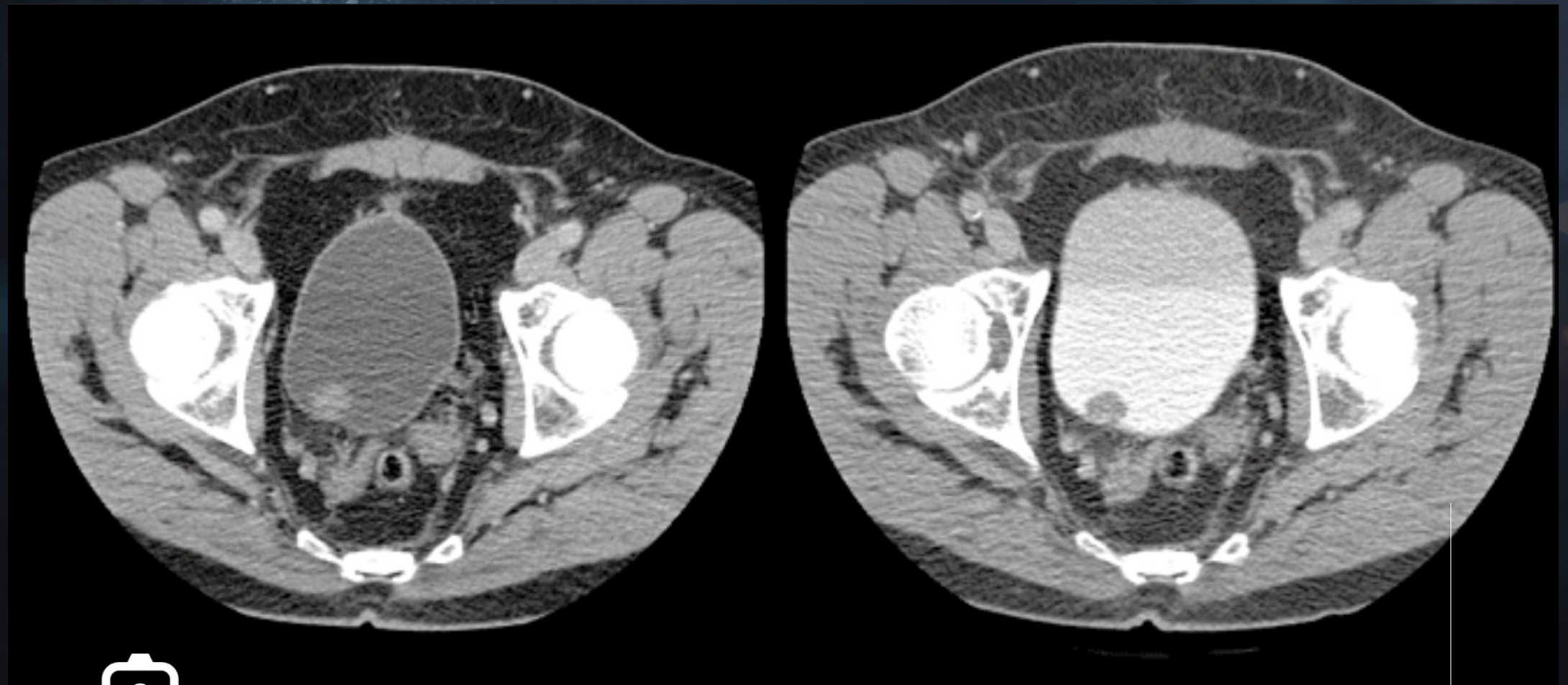
Procedure	Appropriateness Category	Relative Radiation Level
MRU without and with IV contrast	May Be Appropriate	O
CT abdomen and pelvis with IV contrast	May Be Appropriate	☢☢☢
CTU without and with IV contrast	May Be Appropriate	☢☢☢☢
US color Doppler kidneys and bladder retroperitoneal	Usually Not Appropriate	O
US kidneys and bladder retroperitoneal	Usually Not Appropriate	O
Radiography abdomen and pelvis	Usually Not Appropriate	☢☢
Radiography intravenous urography	Usually Not Appropriate	☢☢☢
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRU without IV contrast	Usually Not Appropriate	O
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

CT Urogram includes:

CT a/p non-contrast: stones

CT a/p w/ IV contrast: enhancing masses

CT a/p w/ IV delay: collecting system



A 39-year-old woman in the hospital for presents with intermittent episodes of right upper quadrant pain that began a few months ago. She describes the pain as dull and lasting about 1-2 hours after meals, especially following fatty foods. She also reports mild nausea but denies vomiting, fever, or jaundice. She refuses meals. Physical examination is unremarkable with no tenderness or guarding.

You are called for an admission. The ER has ordered a CT abdomen/pelvis.

Gallbladder

What is the best first imaging for right upper quadrant pain with suspected biliary disease?

American College of Radiology
ACR Appropriateness Criteria®
Right Upper Quadrant Pain

Variant 1: **Right upper quadrant pain. Unknown etiology. Initial Imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US abdomen	Usually Appropriate	O
CT abdomen with IV contrast	Usually Appropriate	☢☢☢
Radiography abdomen	May Be Appropriate (Disagreement)	☢☢
MRI abdomen without and with IV contrast with MRCP	May Be Appropriate	O
MRI abdomen without IV contrast with MRCP	May Be Appropriate	O
CT abdomen without IV contrast	May Be Appropriate	☢☢☢
Nuclear medicine scan gallbladder	Usually Not Appropriate	☢☢
CT abdomen without and with IV contrast	Usually Not Appropriate	☢☢☢☢

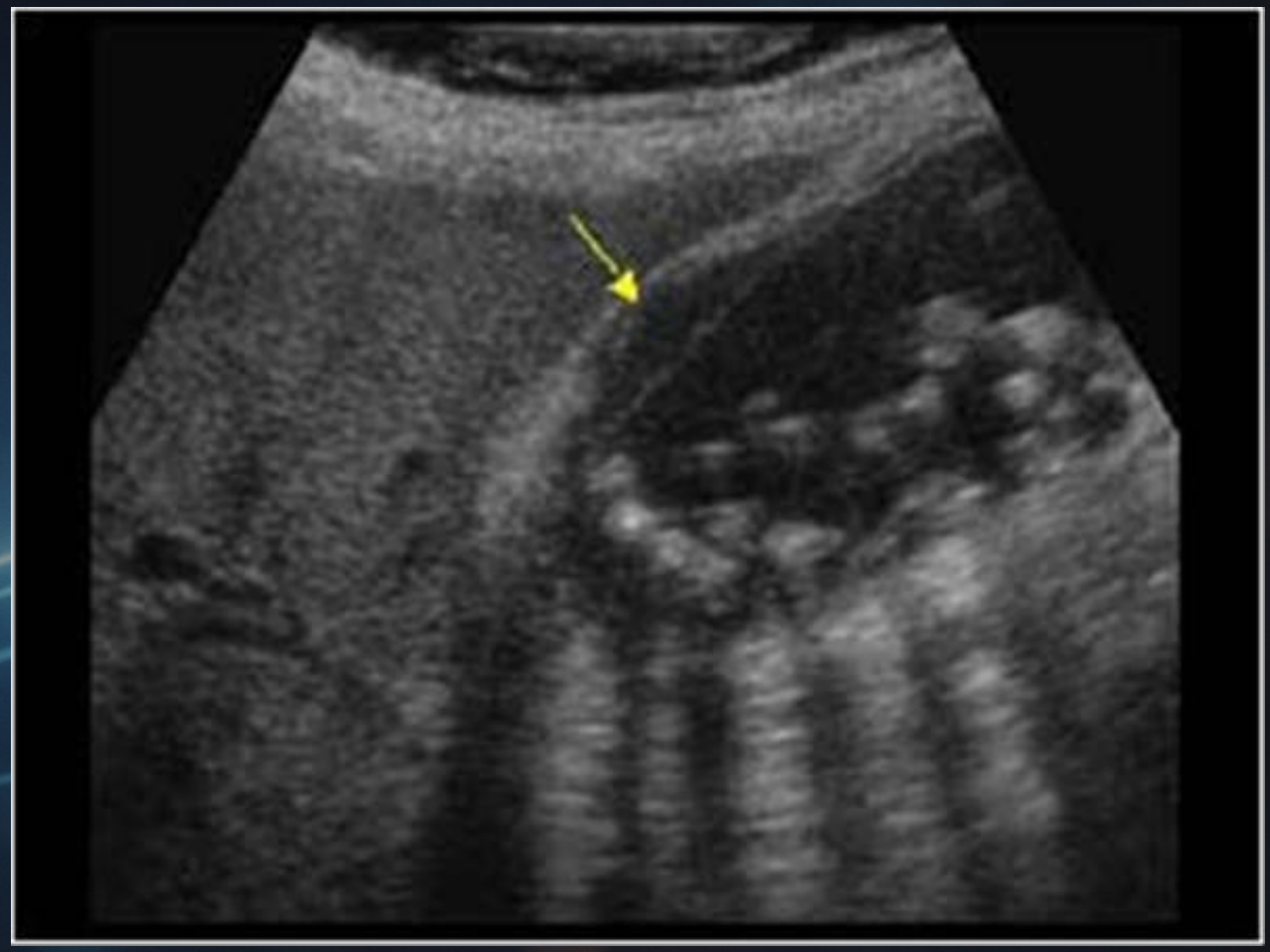
Variant 2: **Right upper quadrant pain. Suspected biliary disease. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US abdomen	Usually Appropriate	O
CT abdomen with IV contrast	May Be Appropriate	☢☢☢
MRI abdomen without and with IV contrast with MRCP	May Be Appropriate	O
MRI abdomen without IV contrast with MRCP	May Be Appropriate	O
Nuclear medicine scan gallbladder	May Be Appropriate	☢☢
CT abdomen without IV contrast	May Be Appropriate	☢☢☢
CT abdomen without and with IV contrast	Usually Not Appropriate	☢☢☢☢

An ultrasound is performed

What ultrasound findings are expected in cholecystitis?

Cholelithiasis without cholecystitis



Cholelithiasis with cholecystitis

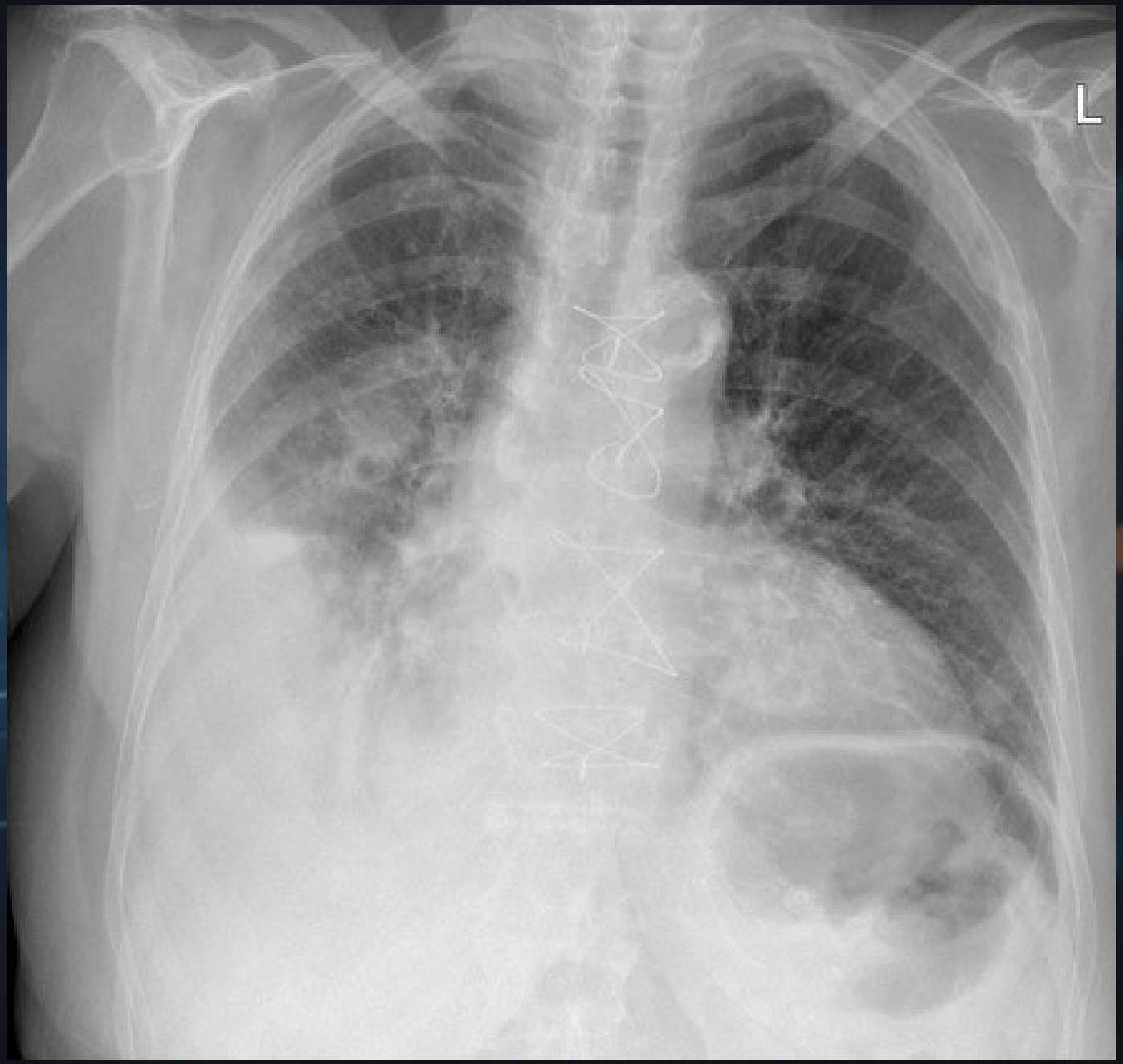
A 68-year-old male with a history of chronic obstructive pulmonary disease (COPD) presents with worsening shortness of breath, increased sputum production, and a productive cough for the past three days. He reports that his sputum has turned a yellow-green color, and he has felt more fatigued than usual. He denies chest pain, but his wife notes he has been slightly more confused today. His past medical history includes a 40-pack-year smoking history, hypertension, and hyperlipidemia.

- Vital signs: Temp 38.1°C, HR 105, BP 135/85 mmHg, RR 26, SpO_2 88% on room ai
- Decreased breath sounds in the right lower lung field and crackles in the right low
- Use of accessory muscles noted during respiration.

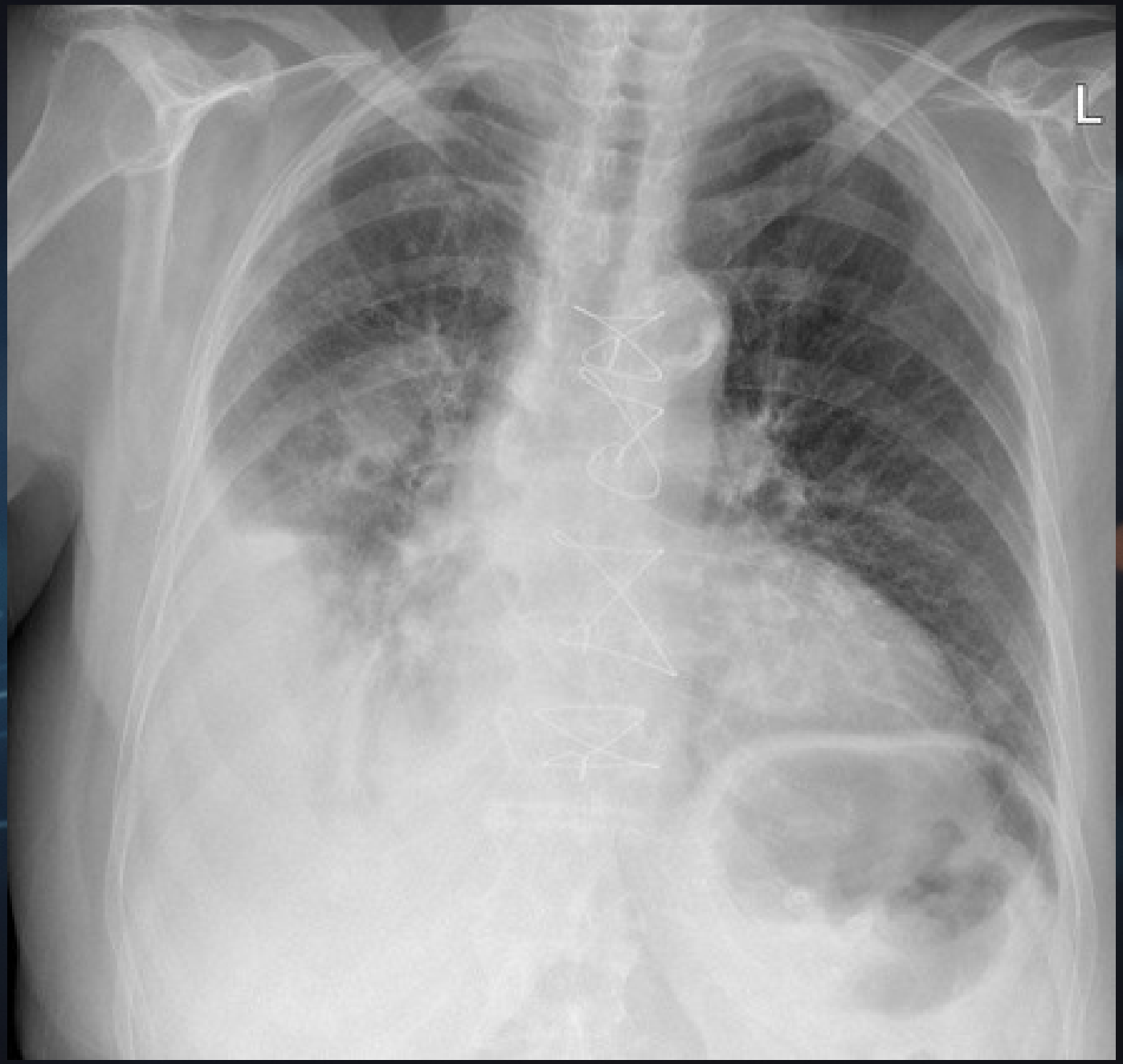
Is imaging clinically indicated?

Variant 2: **Adult. Acute respiratory illness in immunocompetent patients with positive physical examination or abnormal vital signs or organic brain disease or other risk factors for poor outcome. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☢
US chest	Usually Not Appropriate	O
MRI chest without and with IV contrast	Usually Not Appropriate	O
MRI chest without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
CTA chest with IV contrast	Usually Not Appropriate	☢☢☢
V/Q scan lung	Usually Not Appropriate	☢☢☢

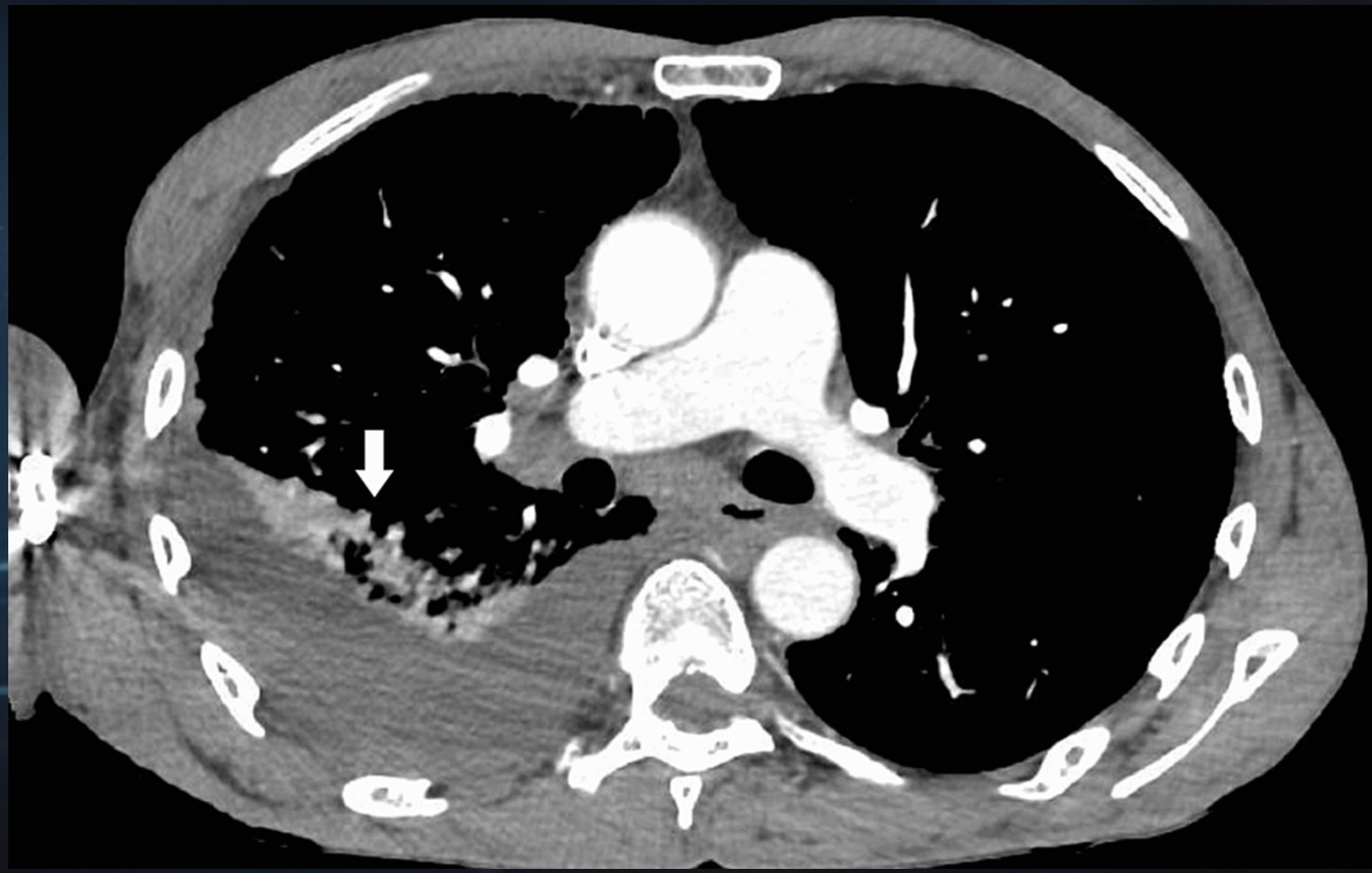

L

Is further imaging appropriate?

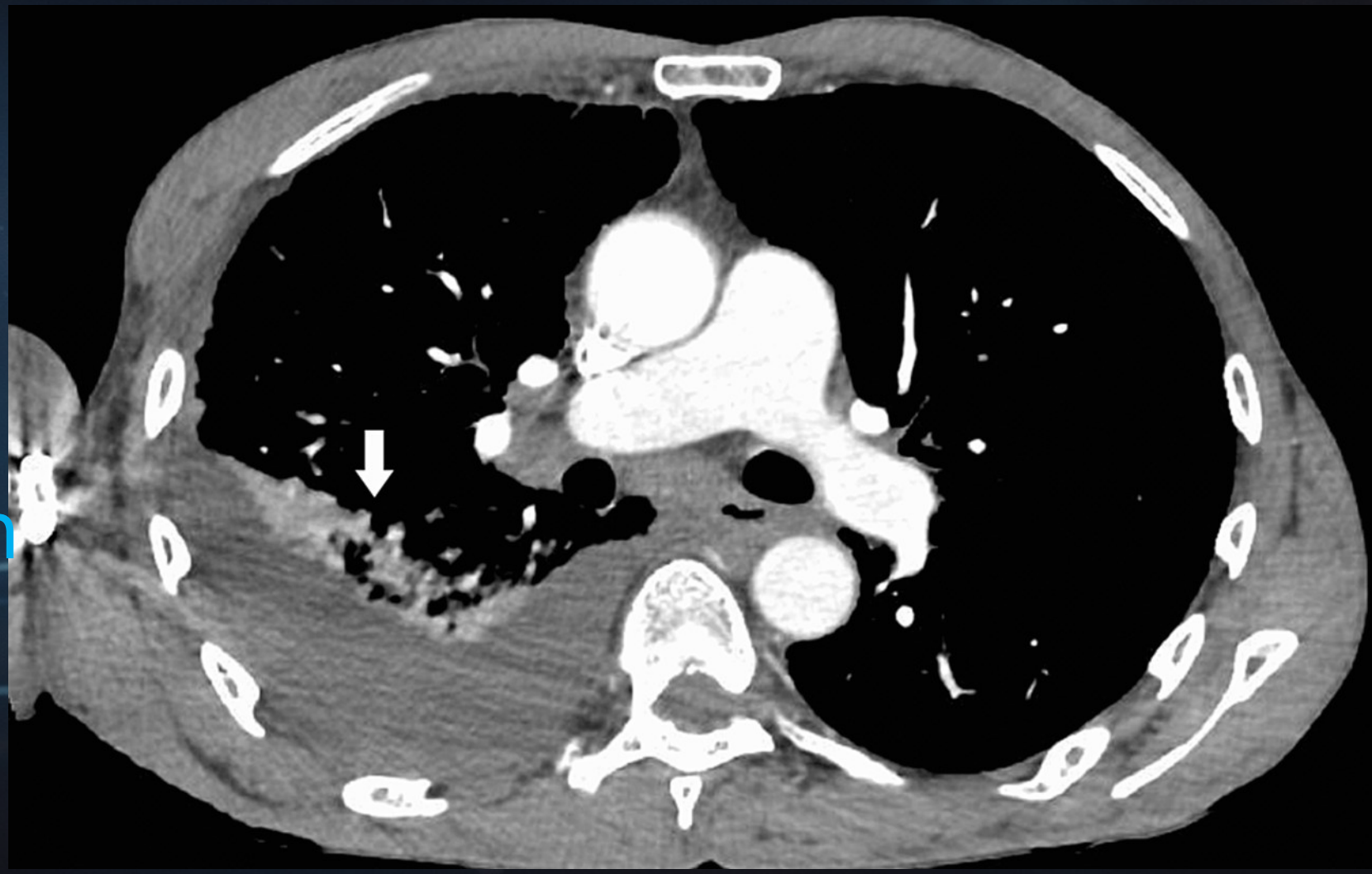


Variant 4: **Adult. Acute respiratory illness in immunocompetent patients with pneumonia complicated by suspected parapneumonic effusion or abscess on initial chest radiograph. Next imaging study.**

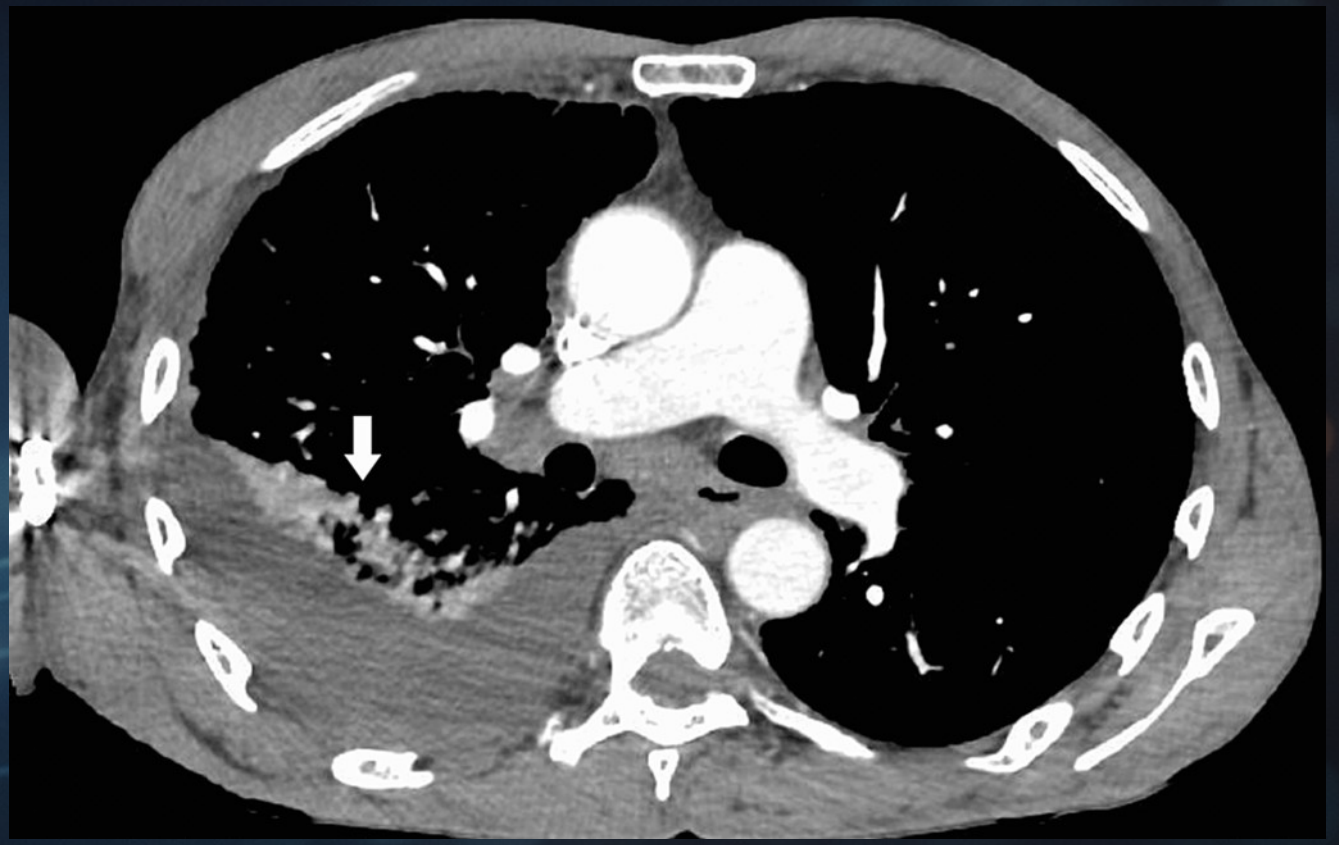
Procedure	Appropriateness Category	Relative Radiation Level
CT chest with IV contrast	Usually Appropriate	☢☢☢
CT chest without IV contrast	Usually Appropriate	☢☢☢
US chest	May Be Appropriate	O
MRI chest without and with IV contrast	Usually Not Appropriate	O
MRI chest without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA chest with IV contrast	Usually Not Appropriate	☢☢☢
V/Q scan lung	Usually Not Appropriate	☢☢☢



What findings distinguish an uncomplicated parapneumonic effusion from an empyema?



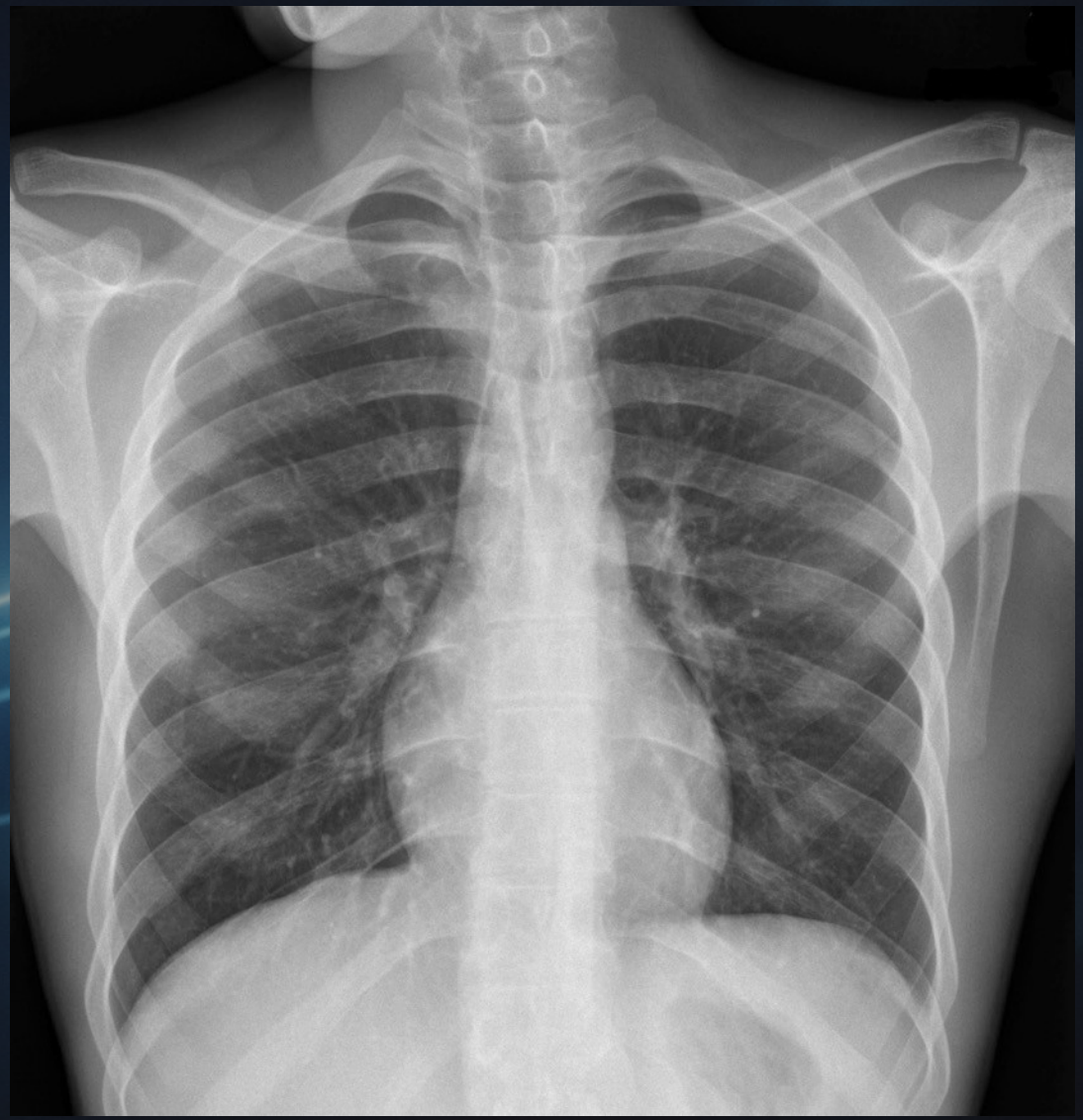
Empyema



Parapneumonic effusion

HUNTING FOR EFFUSIONS

This patient has a pleural effusion

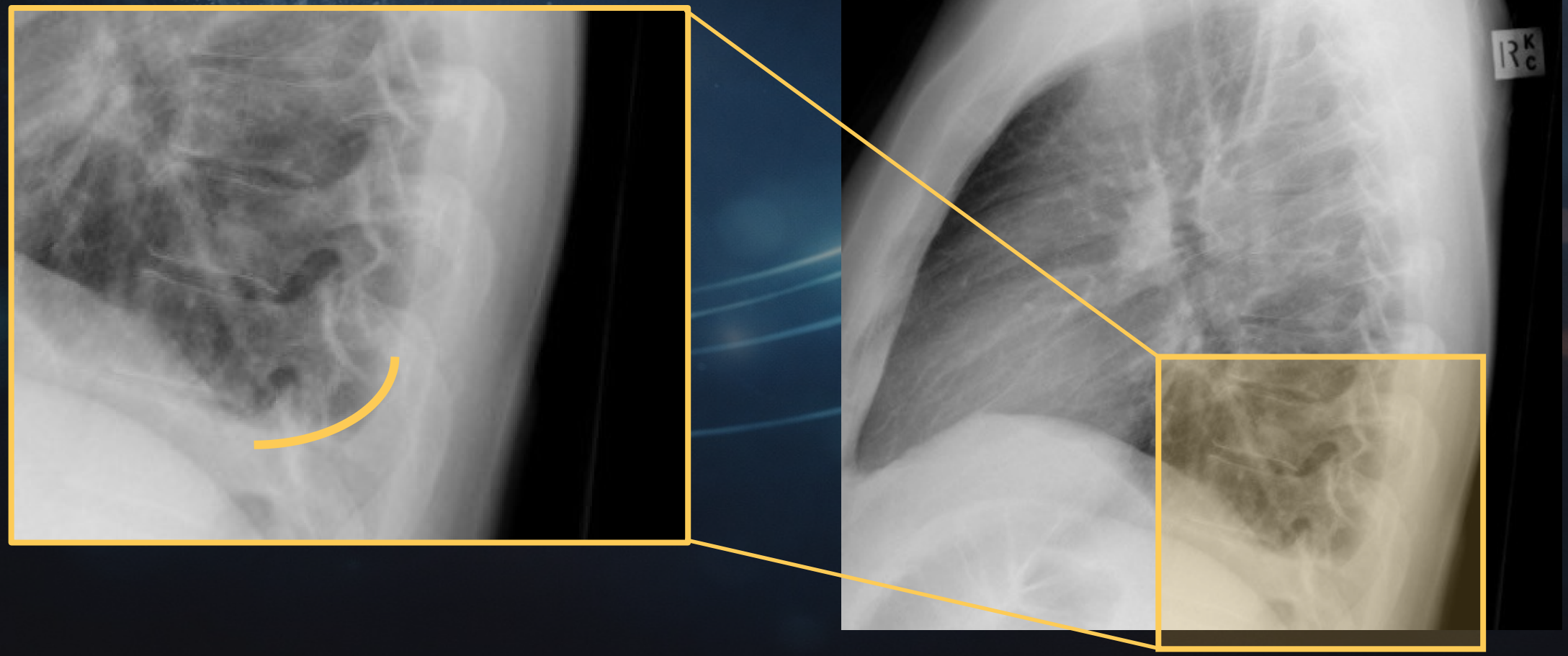


HUNTING FOR EFFUSIONS

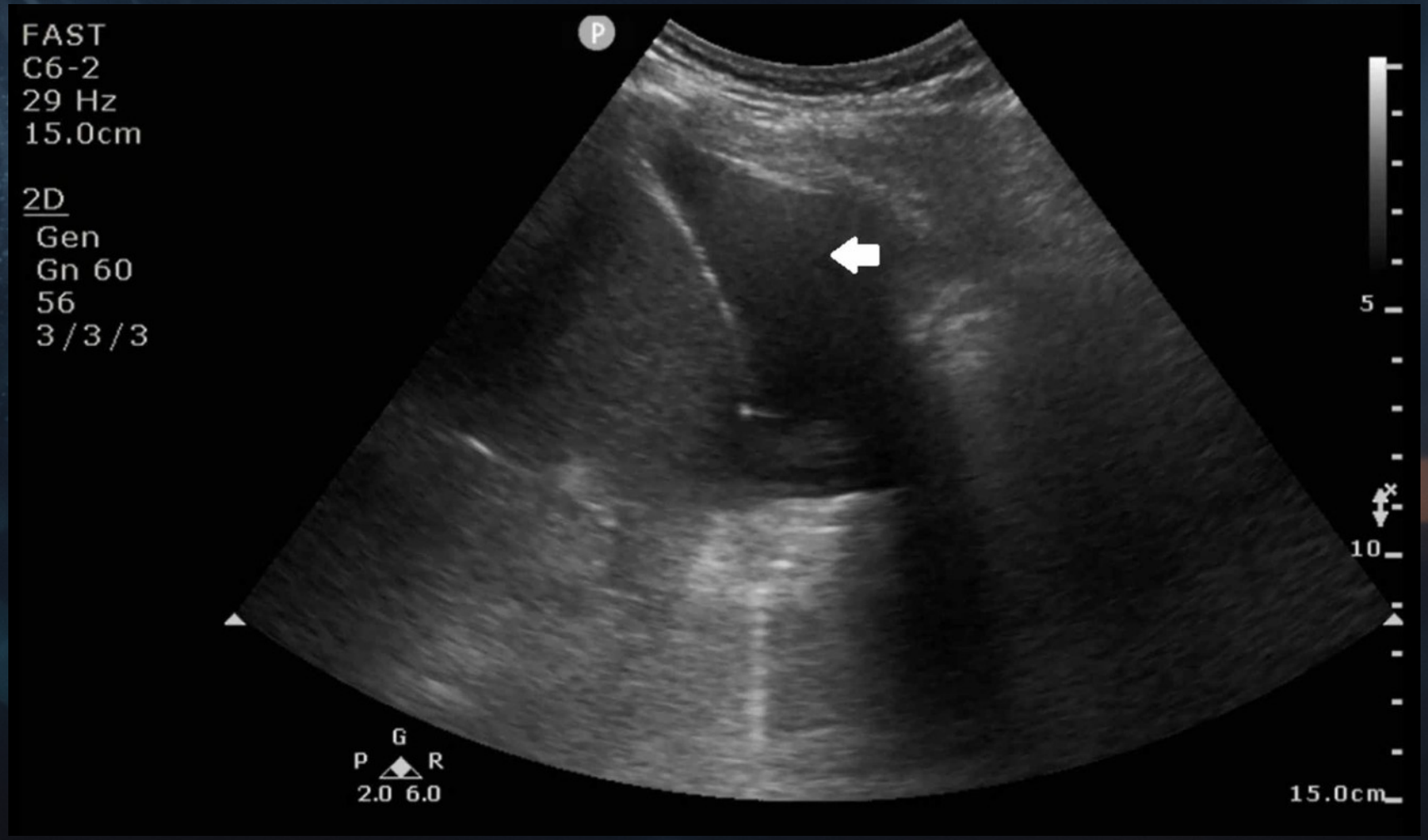
But where?

HUNTING FOR EFFUSIONS

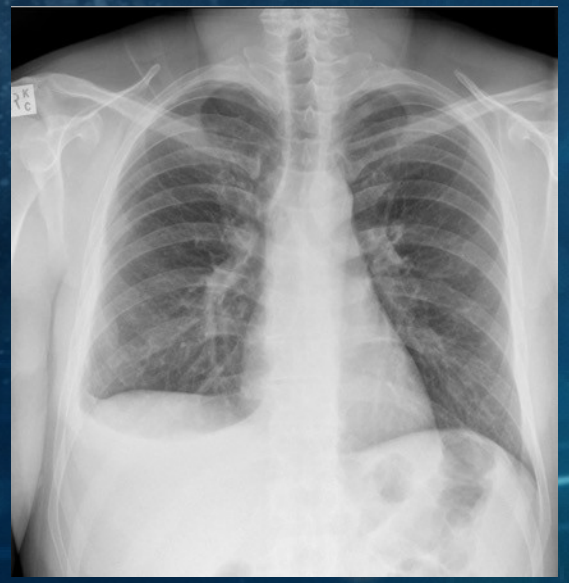
There it is!

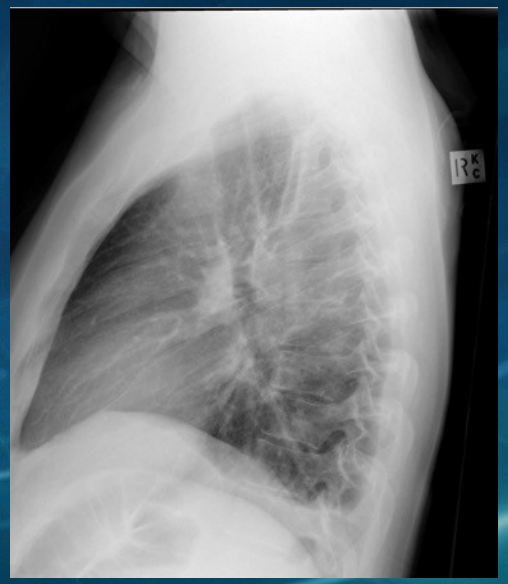


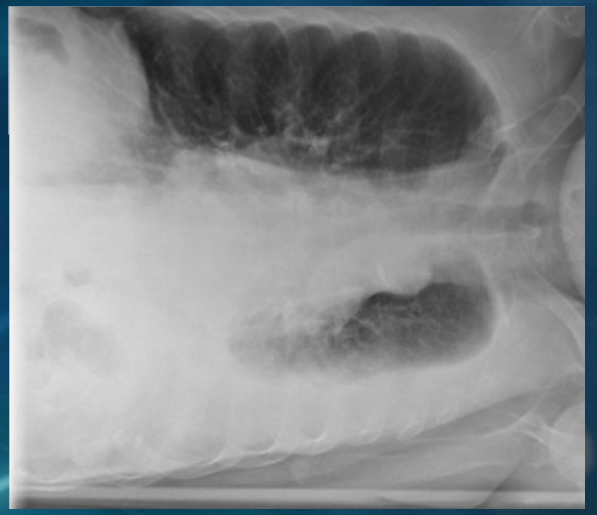
HUNTING FOR EFFUSIONS



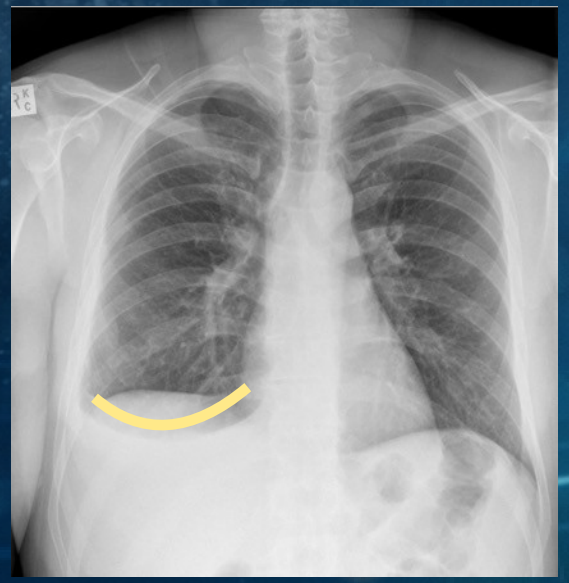
Pleural effusions: The Meniscus Sign

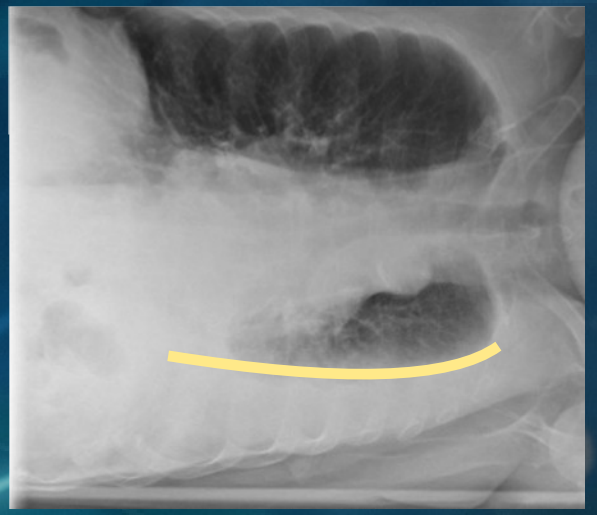






Pleural effusions: The Meniscus Sign





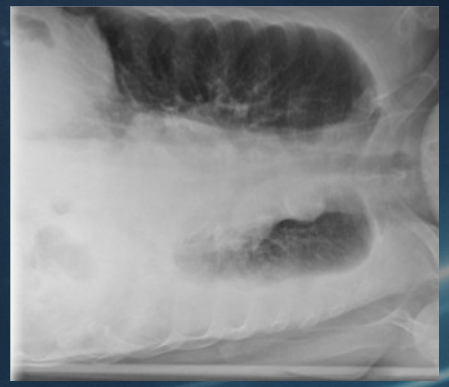
Sensitivity

Upright PA CXR

200 mL

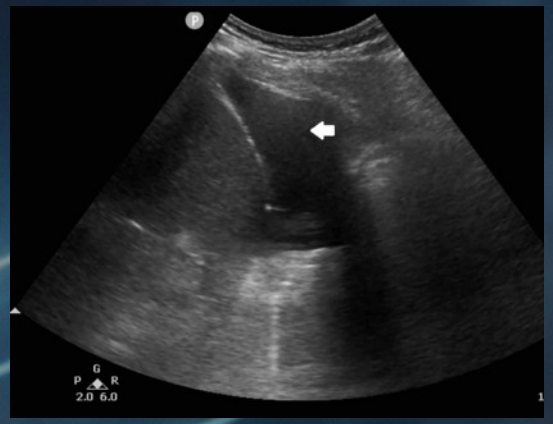
Lateral CXR

50 mL



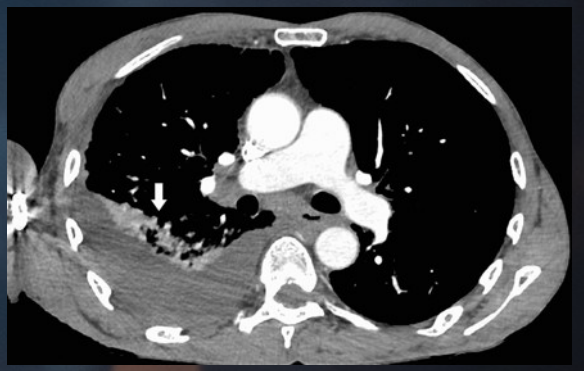
Decubitus CXR

15 mL



US

5 mL



CT

2 mL

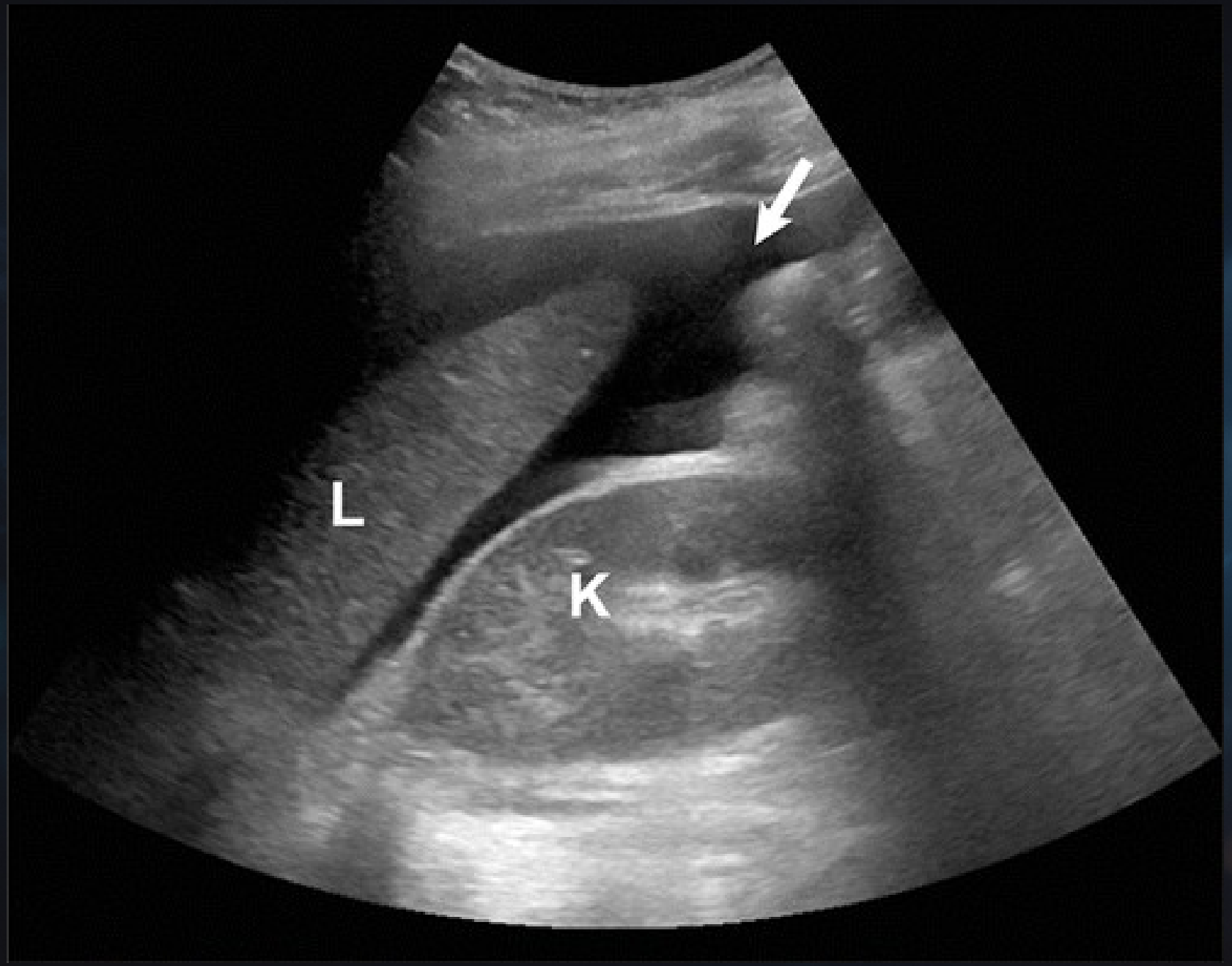
A 27-year-old woman with a history of irregular menstrual cycles is currently hospitalized on the internal medicine service for management of anemia due to iron deficiency. On her third day of hospitalization, she suddenly develops severe lower abdominal pain, described as sharp and constant, and becomes lightheaded. Her blood pressure is 88/56 mmHg, heart rate is 118 bpm, and she appears diaphoretic. On examination, she has marked tenderness in the lower abdomen with rebound and guarding. Her last menstrual period was approximately six weeks ago.

You have access to POCUS. What might you scan?

Liver
IVC
RA

Patient

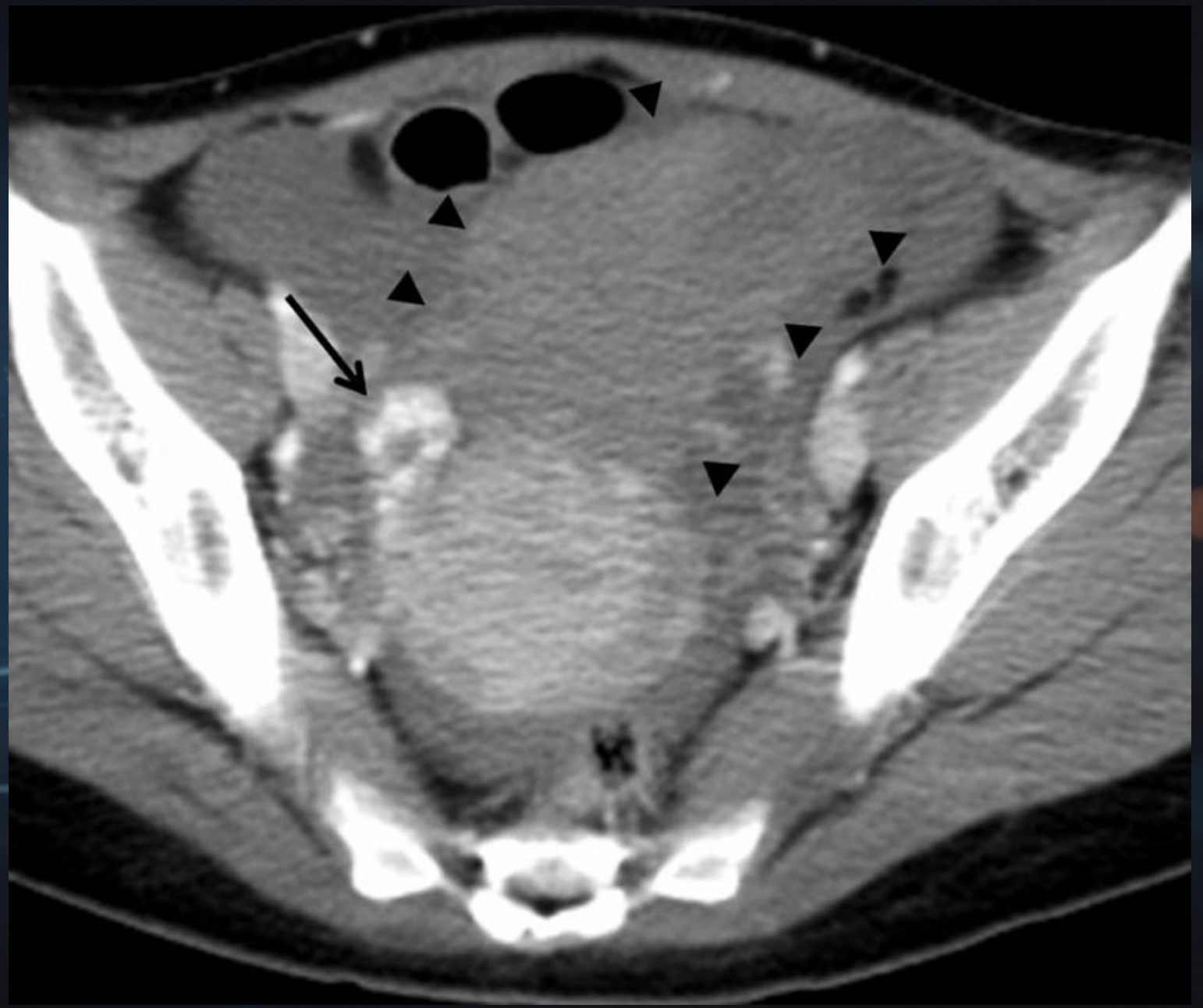
Normal comparison

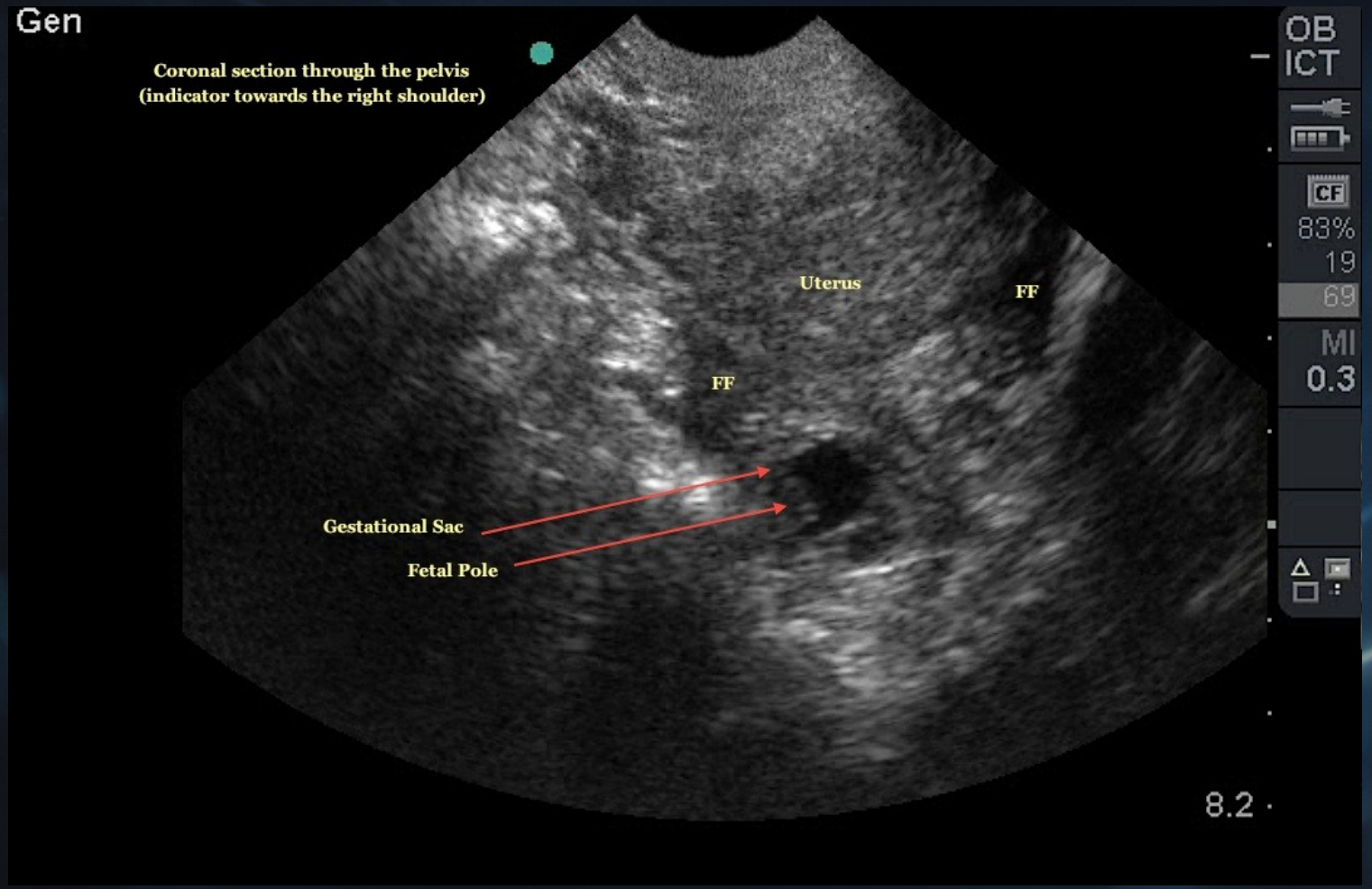


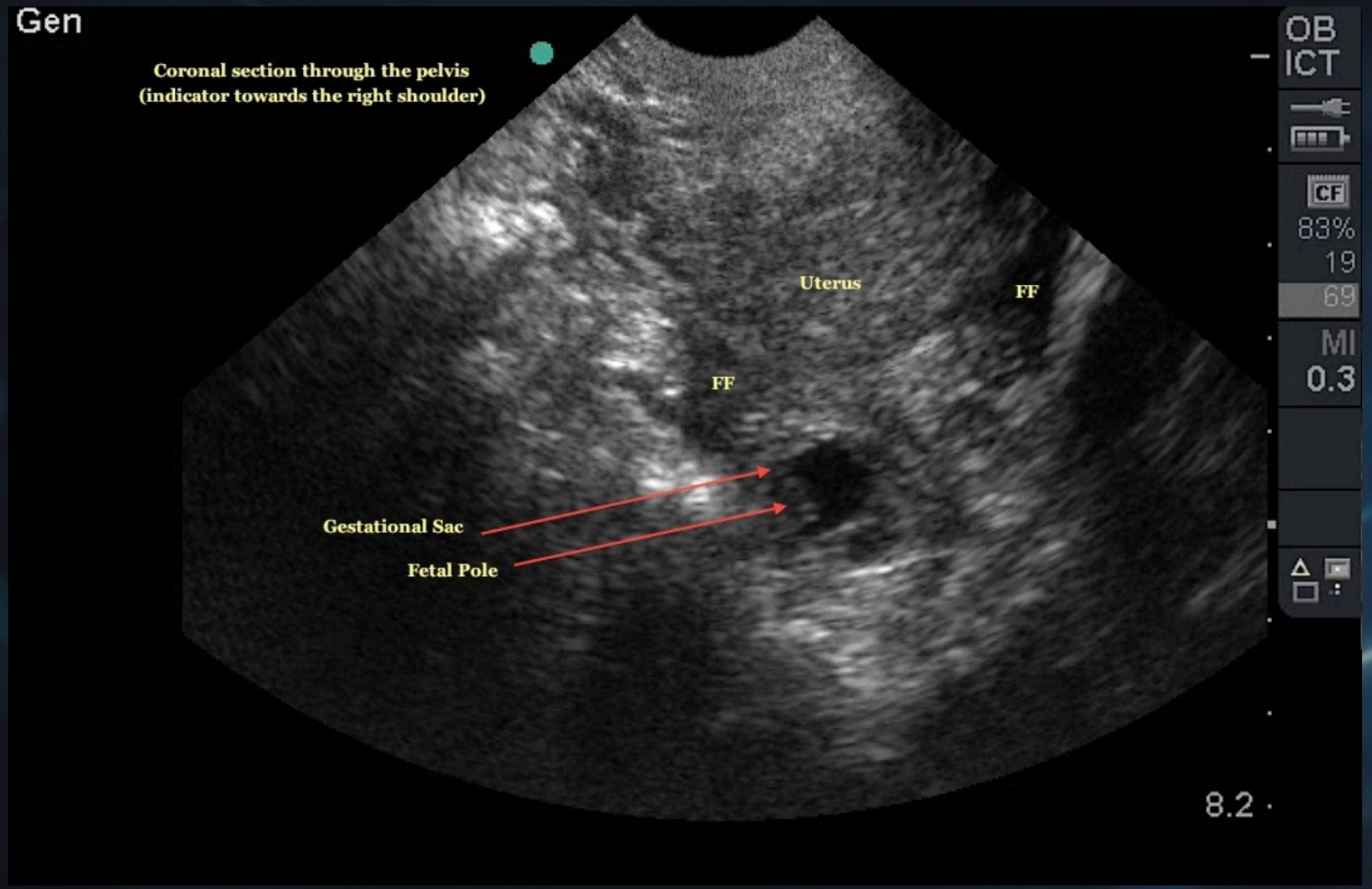
Morrison's Pouch

Where should we look next in this patient?

CT Abdomen/Pelvis




Gen
Coronal section through the pelvis
(indicator towards the right shoulder)
Uterus
FF
FF
Gestational Sac
Fetal Pole
OB
ICT
CF
83%
19
69
MI
0.3
8.2



- Pregnant patient
- HCG > 2000
- Empty uterus
- Adnexal mass

Must suspect
ectopic pregnancy

Case 6 — Acute Pancreatitis

34-year-old male

Heavy alcohol use

Severe epigastric pain radiating to back × 12 hours

Nausea, vomiting, unable to eat

Lipase: 1,847 U/L

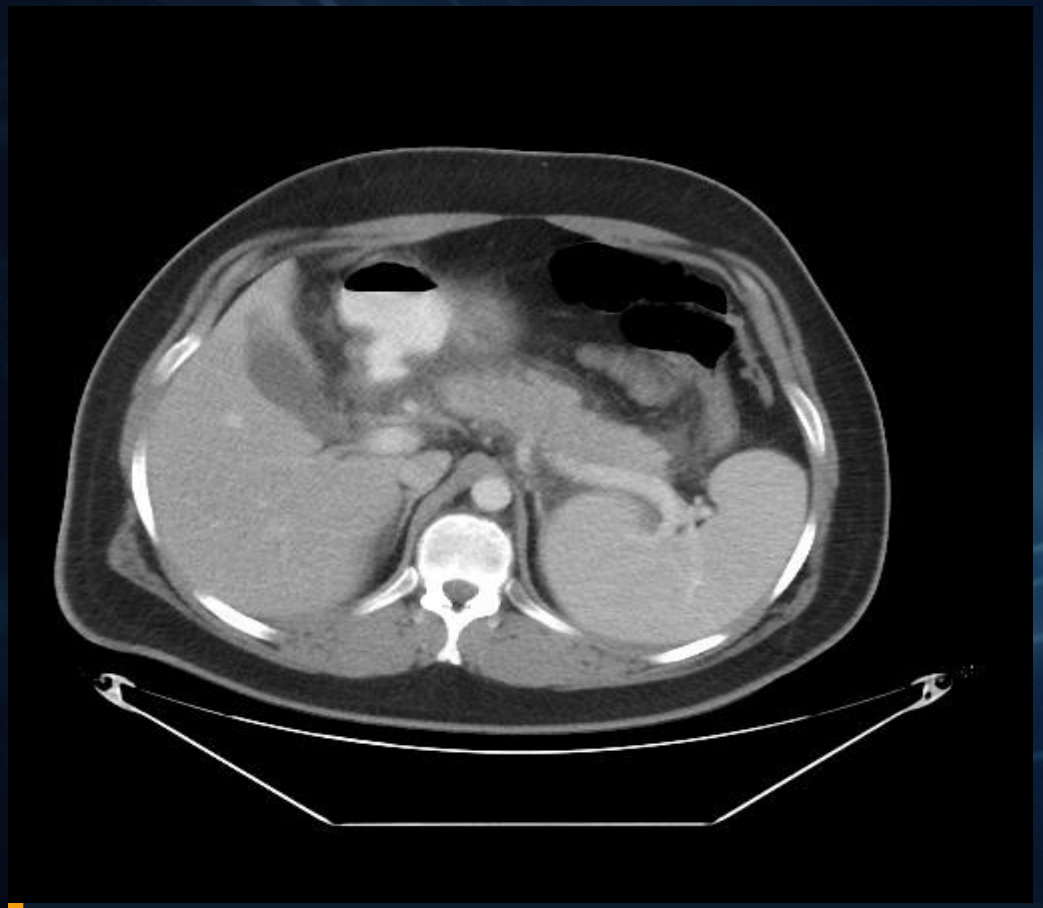
ER ordered: **CT abdomen/pelvis with IV contrast**

What imaging would you order?

Acute pancreatitis is a clinical diagnosis — lipase ≥ 3× ULN + characteristic pain is sufficient

Day 1 CT — What We See (and What We Miss)

Early imaging underestimates severity



What you see

Mild pancreatic swelling

Peripancreatic fat stranding

Small peripancreatic fluid

What you miss

CT within 48–72h underestimates necrosis

Cannot distinguish edematous vs. necrotizing

Optimal CT timing: 72–96 hours after symptom onset, and only if clinically indicated

Day 7 — Now We Image

Clinical deterioration triggers repeat CT

CT Severity Index (Balthazar)

Grade A–B	Normal / edema only	**0–1**
Grade C–D	Collections, 30–50% necrosis	**2–6**
Grade E	> 50% necrosis	**7–10**

Management pivot

Percutaneous drainage if accessible collection

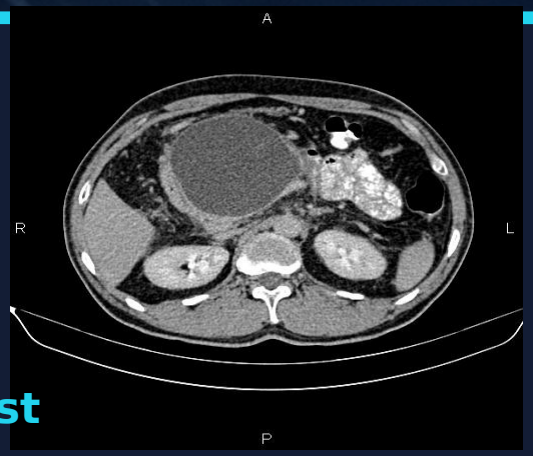
Antibiotics if infected necrosis (gas bubbles on CT)

Surgery / IR consult for walled-off necrosis

Fevers, rising WBC, or organ failure after Day 3 → repeat CT to assess for necrosis and complications

Pancreatitis Complications

The imaging gallery

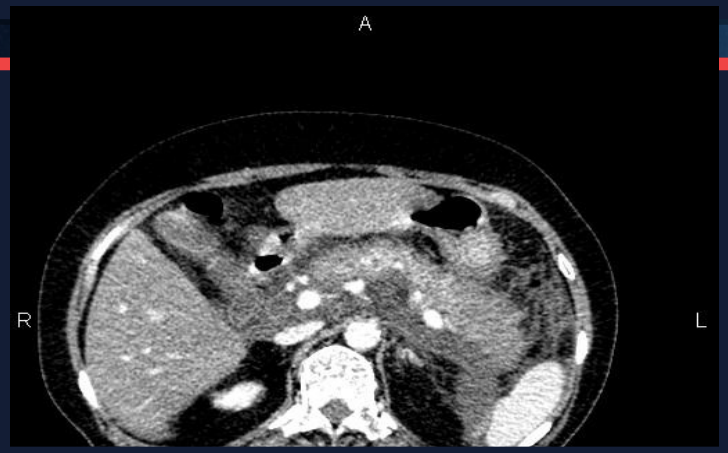


Pseudocyst

Well-defined wall, homogeneous fluid, ≥ 4 weeks

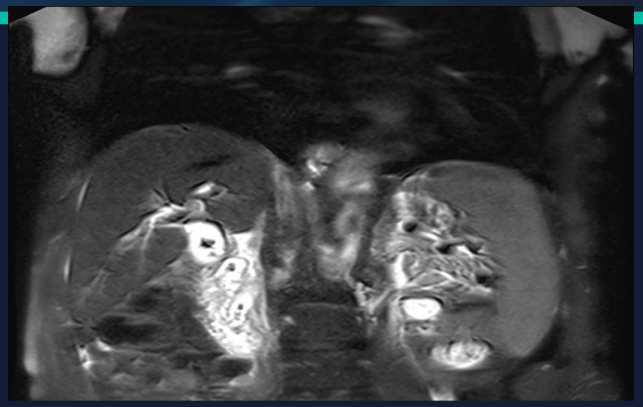
Walled-Off Necrosis

Heterogeneous, encapsulated, ≥ 4 weeks, may contain gas



Necrotizing Pancreatitis

Non-enhancing parenchyma, < 30 HU, peripancreatic collections



MRCP — Gallstone Etiology

CBD stone visible on MRCP, guides cholecystectomy timing

Pancreatitis — The Imaging Decision Framework

When to image, and when to wait

Day 1

Clinical Dx Sufficient

Lipase + history = diagnosis
US to look for stones

CT only if diagnostic uncertainty (other acute abdomen causes)

Day 3–7

Image if Deteriorating

Fevers, rising WBC

Organ failure

Failure to improve clinically

Week 4+

Image for Complications

Pseudocyst / WON

Pseudoaneurysm

Persistent symptoms

Gallstone etiology? → MRCP before cholecystectomy

Case 7 — Acute Ischemic Stroke

Time is brain

72-year-old woman

Found by family with left-sided weakness, left facial droop, slurred speech

Last known well: 2 hours ago

NIHSS: 14 (moderate-severe)

EMS activates stroke code

2h

since last known well

What imaging do you need, and in what order?

Stroke imaging has a single purpose: determine treatment eligibility as fast as possible

Step 1 — Non-Contrast CT Head

Rule out hemorrhage

Hyperdense MCA sign

Bright clot visible in the Sylvian fissure — thrombus in situ

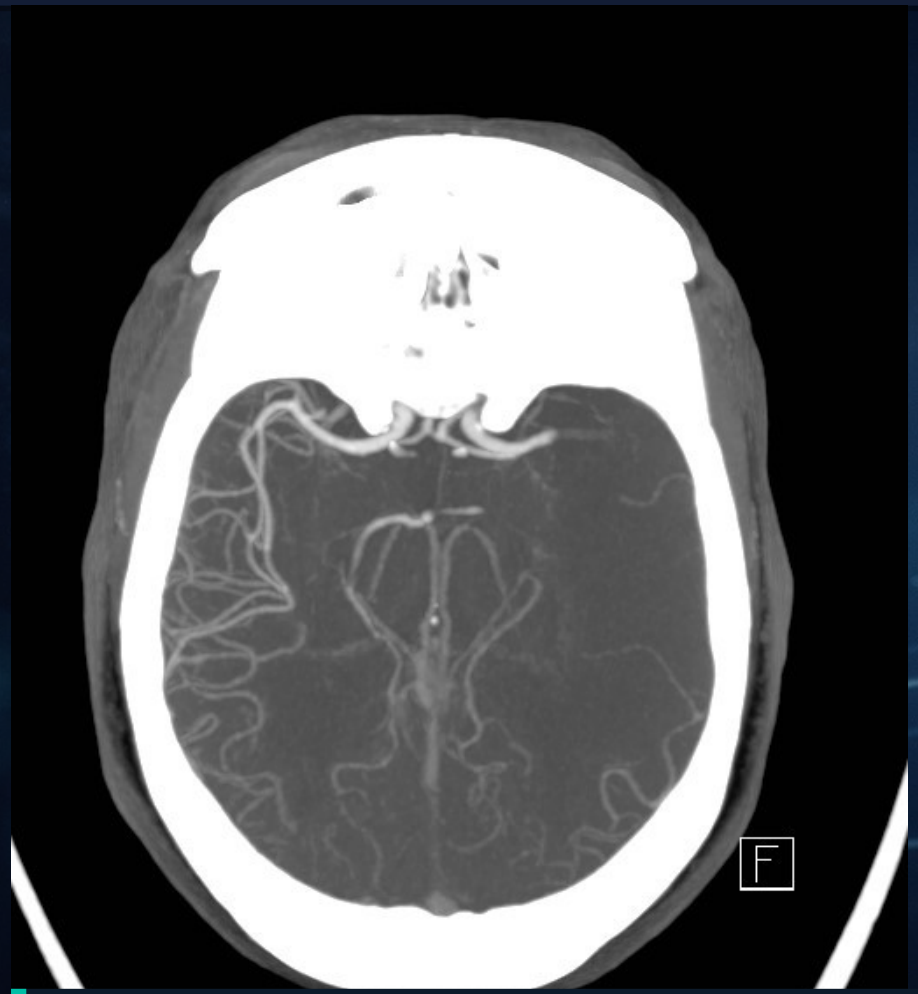
Loss of gray-white differentiation

Early cytotoxic edema

A "normal" CT head does NOT rule out ischemic stroke — it rules out hemorrhage

Step 2 — CTA Head & Neck

Identify large vessel occlusion



Large Vessel Occlusion (LVO)

Abrupt cutoff of contrast in a major vessel:

• ICA terminus • MCA (M1 or M2) • Basilar artery

LVO → potential thrombectomy candidate

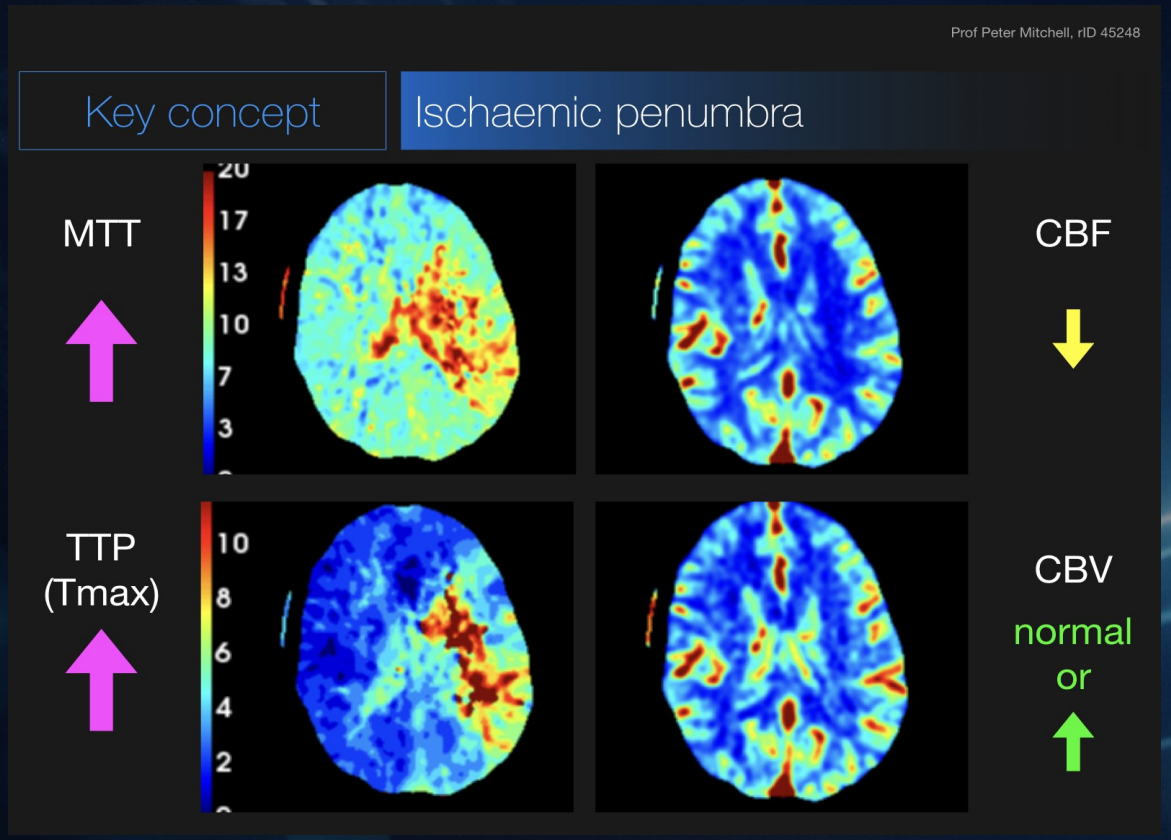
Collateral circulation

Good collaterals = more salvageable tissue = better thrombectomy outcomes

LVO + favorable imaging = thrombectomy candidate (up to 24 hours with perfusion mismatch)

Step 3 — Perfusion Imaging

Core vs. penumbra



Core

Irreversibly infarcted (dead)
CTP: very low CBF | MRI: DWI bright

Penumbra

Ischemic but salvageable (at risk)
CTP: prolonged Tmax, preserved CBV

Mismatch

Large penumbra vs. small core
→ Patient benefits from intervention

DAWN & DEFUSE-3 trials: Perfusion mismatch extended the thrombectomy window from 6 hours to 24 hours

Stroke Imaging — The Timeline

Imaging determines treatment eligibility

0–25 min

NCCT Head

Rule out hemorrhage

Hyperdense vessel sign

0–45 min

CTA Head/Neck

Identify LVO

Assess collaterals

< 4.5 h

tPA Window

CT-eligible

No LVO required

< 24 h

Thrombectomy

LVO + mismatch

DAWN / DEFUSE-3

MRI DWI: Gold standard for defining final infarct — not required for acute treatment decisions, but best for characterization

Take-home: The clock and the scan together decide what you can offer the patient

Case 8 — Headache

58-year-old male

Progressive headaches × 3 weeks — worse in the morning

Generalized tonic-clonic seizure in the ED

Exam: right pronator drift, otherwise non-focal

PMHx: None
Social Hx: Occasional EtOH, 1ppd smoker x 30 years
ROS: Negative
Su

Red Flags

- Progressive worsening
- Morning predominance
- New-onset seizure
- Focal deficit
- Age > 50
- Smoking history

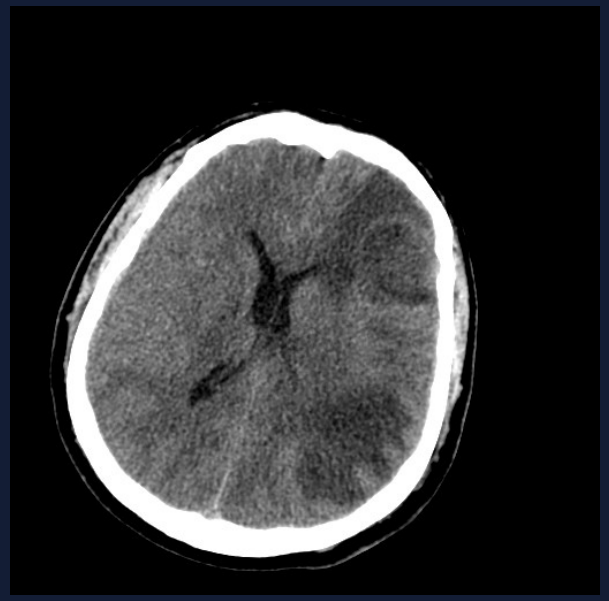
Any of these red flags in a headache patient → imaging is indicated

What's your first imaging study?

CT Head — Without, Then With Contrast

Contrast doesn't find the mass — it characterizes it

Without contrast

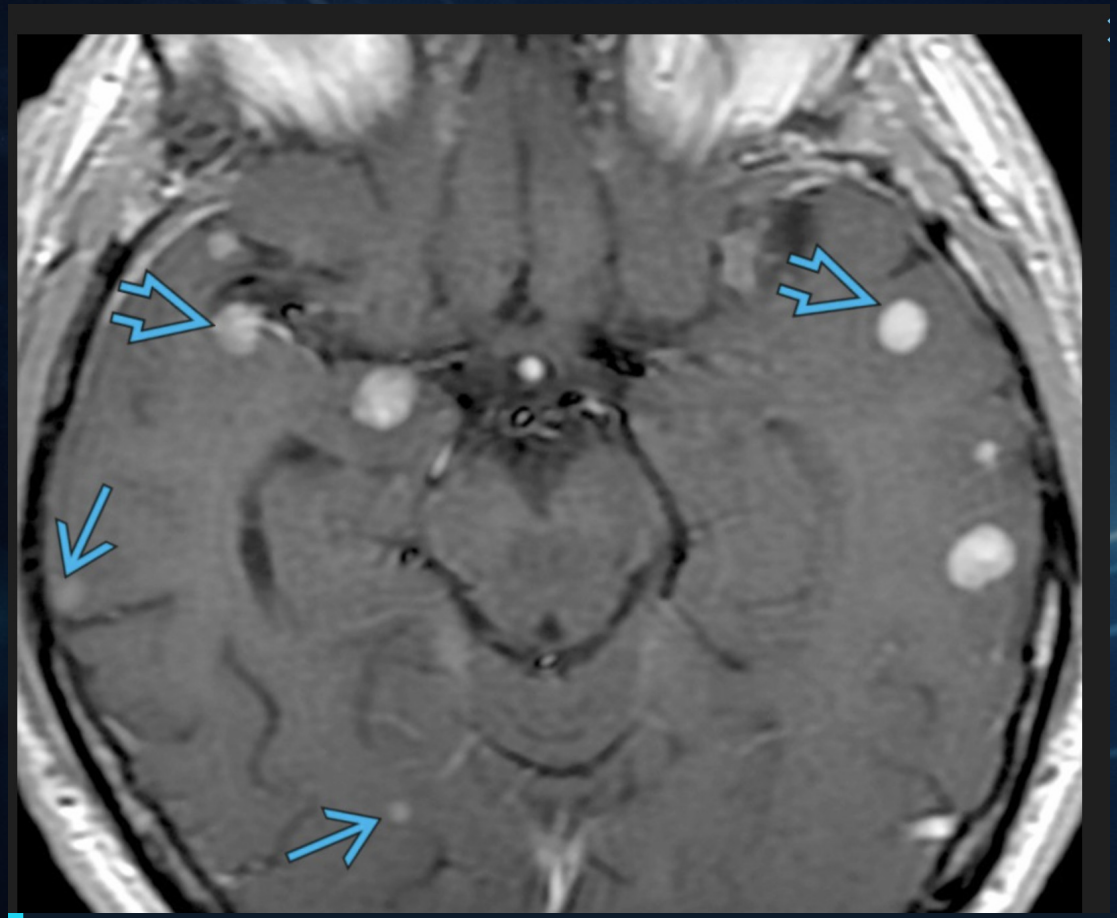


With contrast

Ring-enhancing lesion differential:

- **Metastasis**
- **GBM**
- **Abscess**
- **Lymphoma**

MRI Brain — Why It's Better Here



Sensitivity

MRI detects lesions CT misses — multiple enhancing foci at gray-white junction

Characterization

DWI: no restriction → argues against abscess
Spectroscopy narrows the differential

Surgical Planning

Relationship to eloquent cortex
Guides neurosurgical approach

In this case: MRI reveals true multiplicity of brain lesions

Any other imaging to perform?

Any other imaging to perform?

Any other imaging to perform?

A finding in one organ triggers a whole-body workup

Brain MRI

Multiple enhancing metastases

CT C/A/P

3 cm spiculated RUL mass + LN

PET/CT

Full-body metabolic staging

58-year-old smoker + brain metastases

Lung cancer is the leading suspect

CT chest → staging CT abdomen/pelvis or PET/CT

PET/CT adds functional metabolic data for staging

Brain metastases in a smoker → CT chest is the next study. Understanding the staging pathway helps you counsel the patient.

CT Head — When to Order, When to Upgrade

CT without contrast

New seizure • Acute focal deficit • Head trauma • Thunderclap headache • AMS with focal signs

Add IV contrast

Known/suspected malignancy • Suspected infection/abscess • Lesion seen on NCCT

Go straight to MRI

Progressive neuro symptoms (subacute) • Suspected MS • Posterior fossa pathology • Known brain mets (surveillance)

No imaging needed

Chronic daily headache without red flags • Migraine with typical features • Isolated dizziness, no focal signs

Lightning
Round

IMAGE QUESTION

This is a technically inadequate chest radiograph. With regards to the exposure, is this image **overpenetrated** or **underpenetrated**?

IMAGE QUESTION

What diagnosis explains the patient’s abdominal pain?

CHOOSE: ileus / small bowel obstruction / large bowel obstruction / perforation

MULTIPLE CHOICE #4

On ultrasound imaging, which of the following would be expected to be anechoic (black) on the ultrasound image?

a) Air-filled bowel
b) Renal stone
c) Normal bladder contents
d) Lipoma

IMAGE QUESTION

What is the diagnosis?

IMAGE QUESTION 2

This CT shows acute intracranial hemorrhage. In what space is the blood?

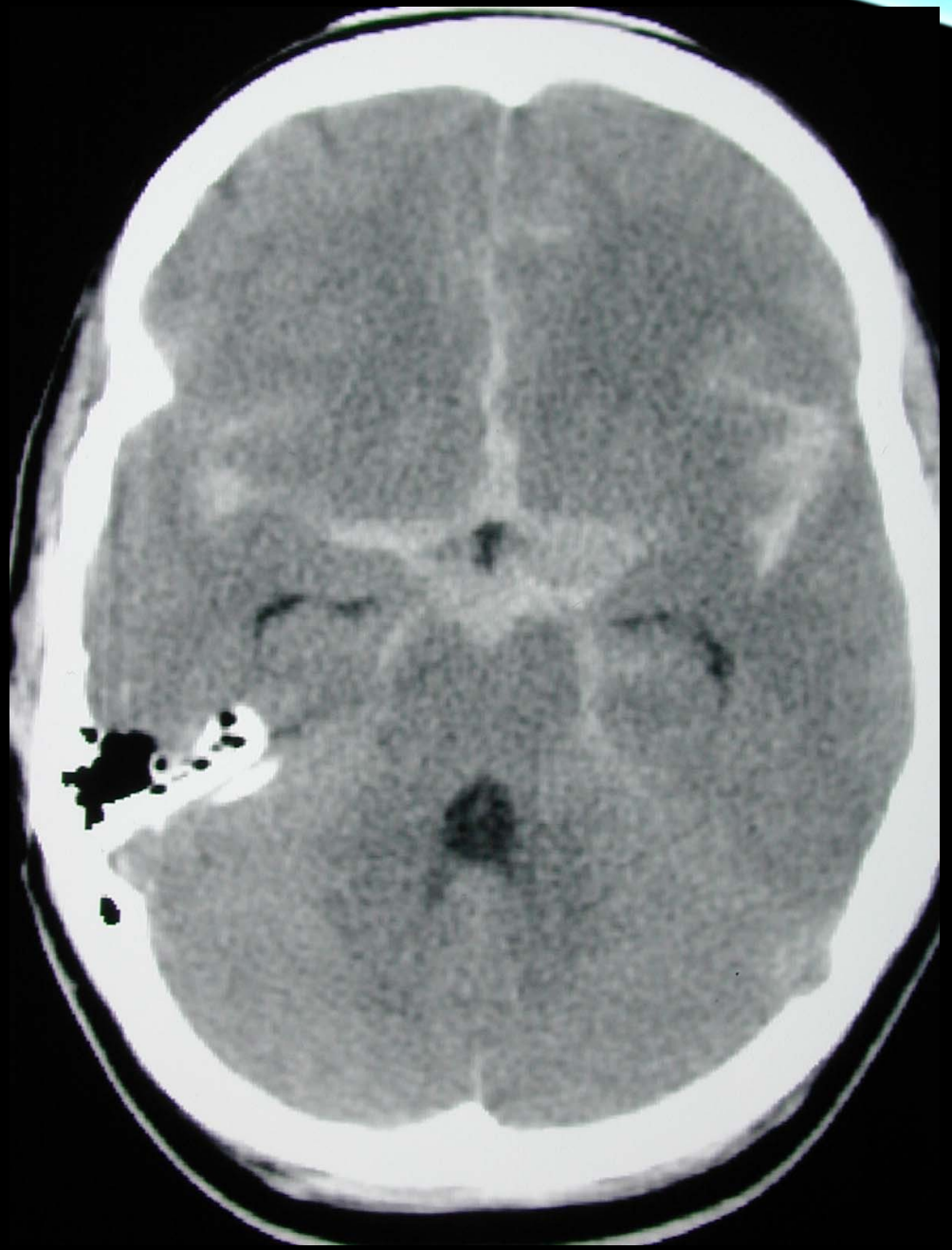


IMAGE QUESTION 3

In what compartment is the hemorrhage for this patient?

IMAGE QUESTION 4

History: Trauma. List your findings.

IMAGE QUESTION 5

What acute pathology is present?

IMAGE QUESTION 6

What is the diagnosis? Be as specific as possible.

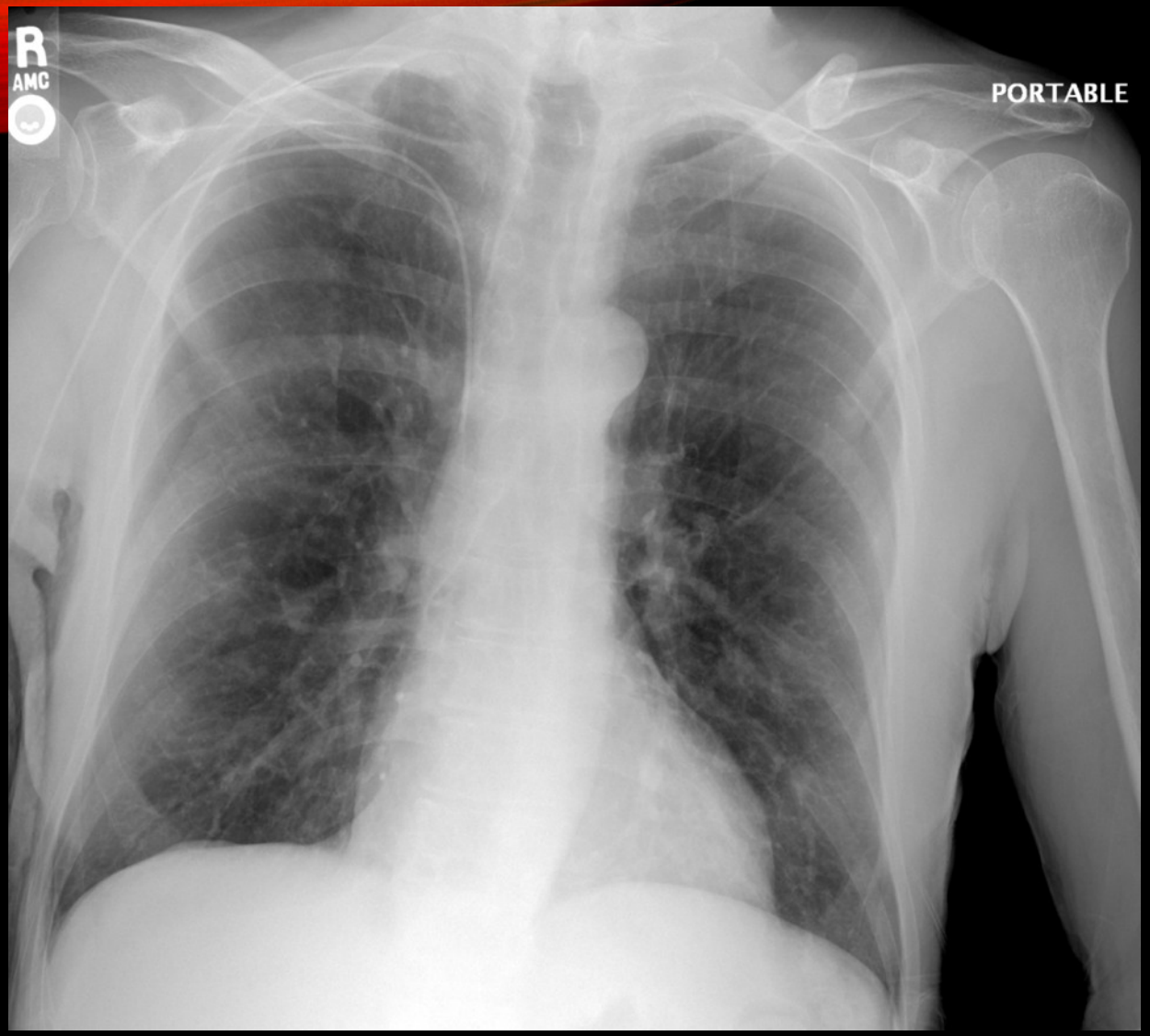


IMAGE QUESTION 7

What line/tube is present?

Is it positioned appropriately?

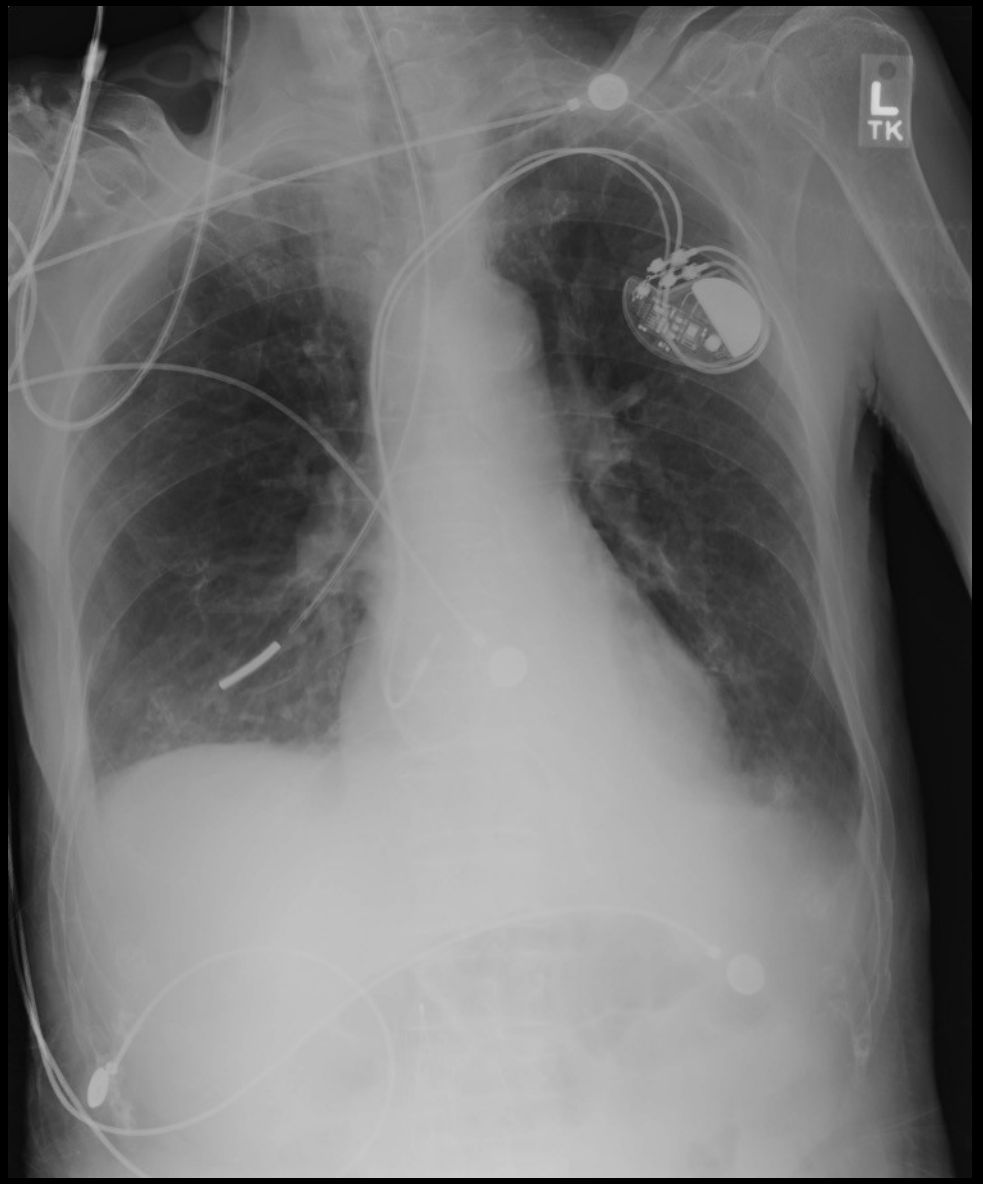
Where is it positioned?

IMAGE QUESTION 8

What line/tube is present?

Is it positioned appropriately?

Where is it positioned?



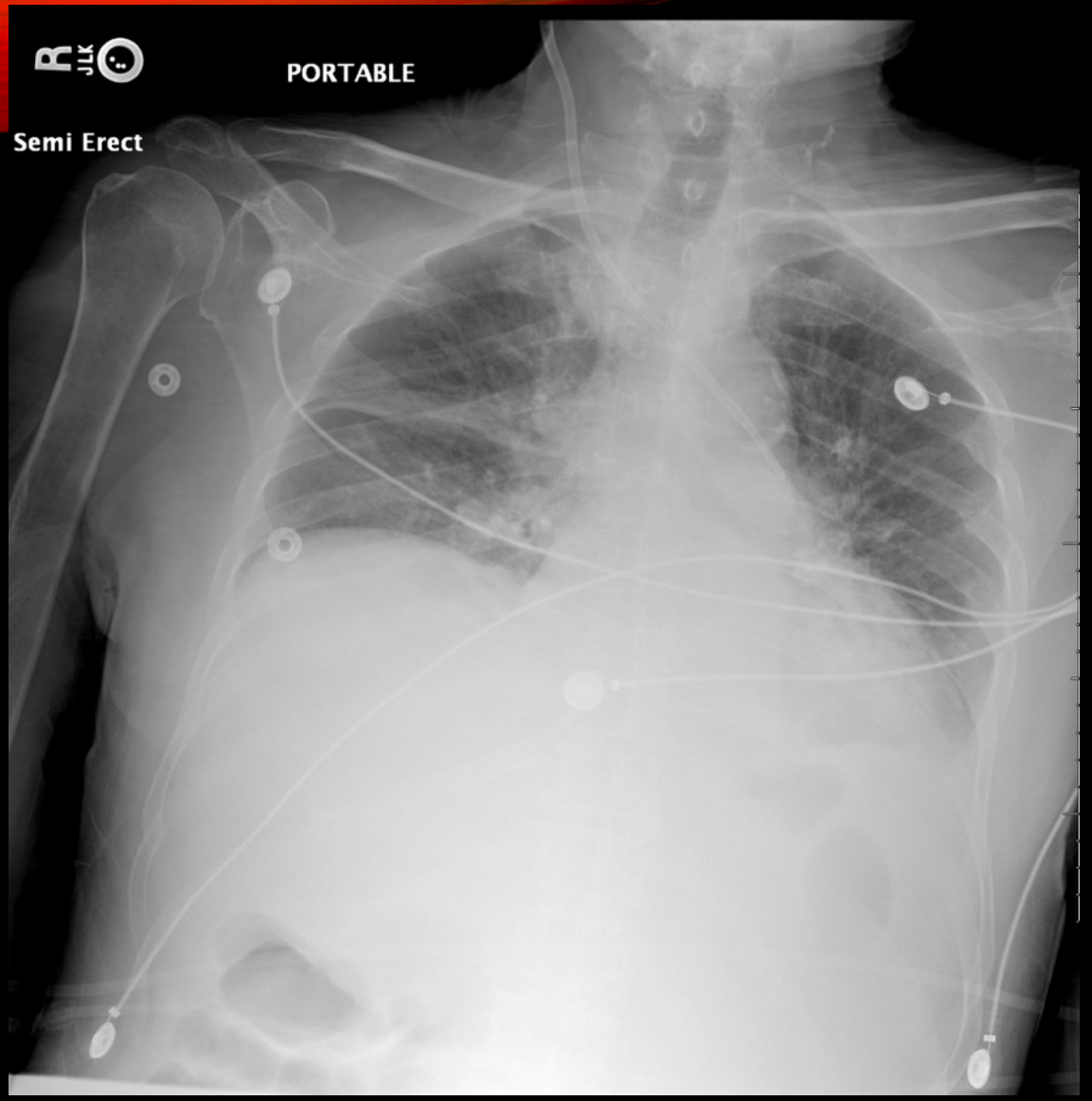


IMAGE QUESTION 9

What line/tube is present?

Is it positioned appropriately?

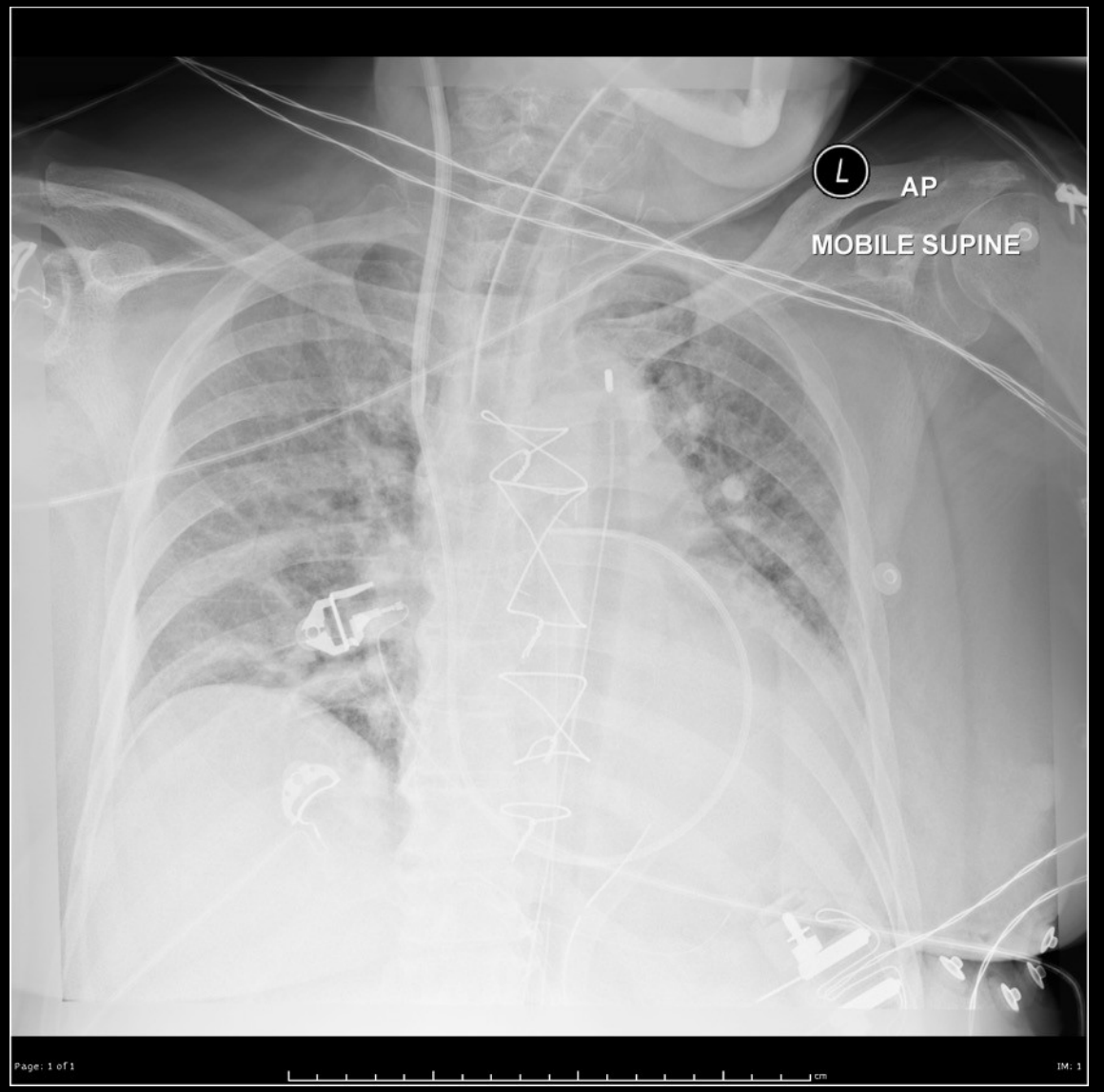
Where is it positioned?

IMAGE QUESTION 10

What lines/tubes are present?

Where are they positioned?

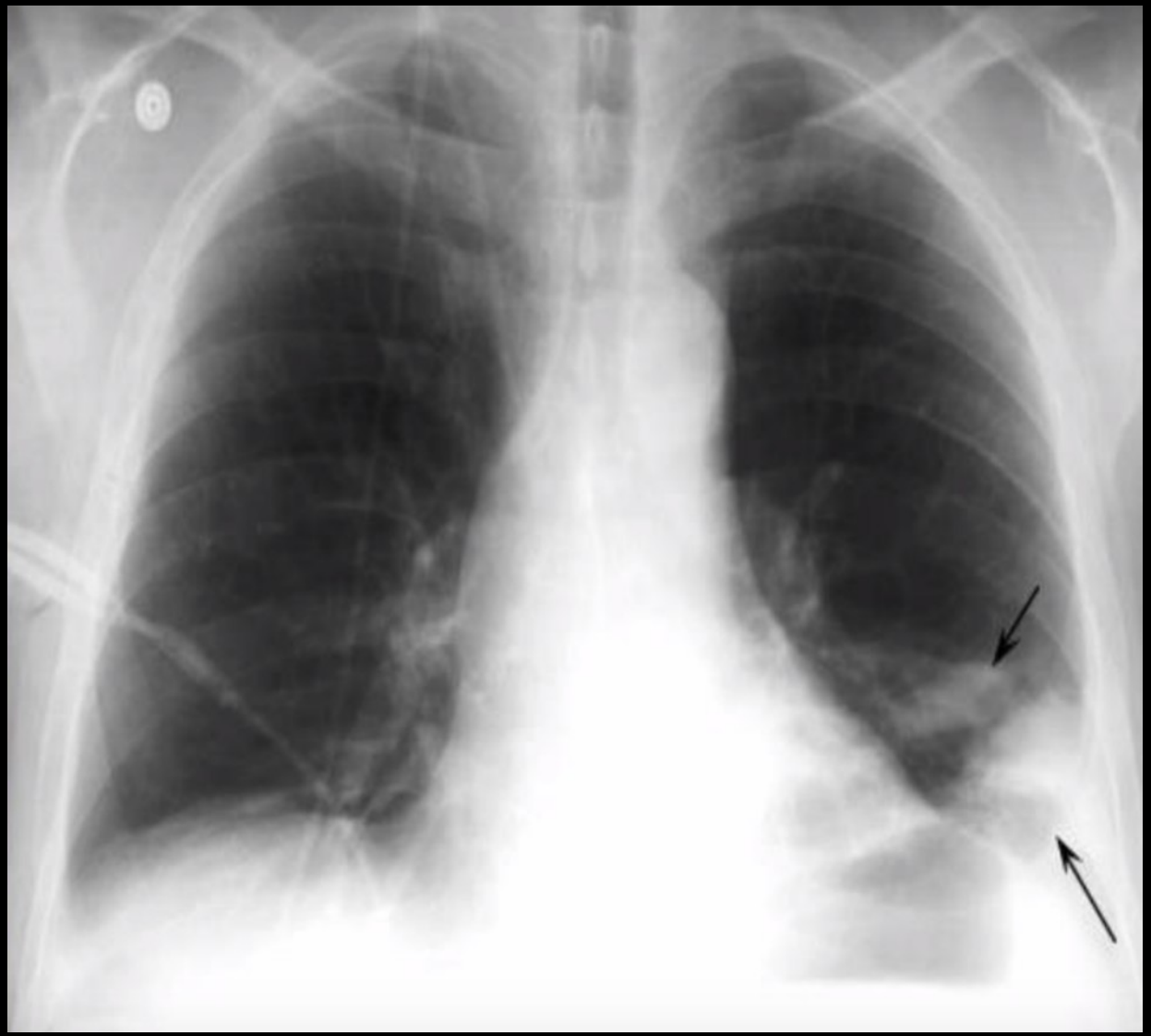
*Ignore the monitor leads
*There are 3 lines/tubes to find



CONCEPT QUESTION #1

Hampton’s hump, a peripheral often wedge-shaped opacity is a characteristic radiographic finding that accompanies pulmonary embolism.

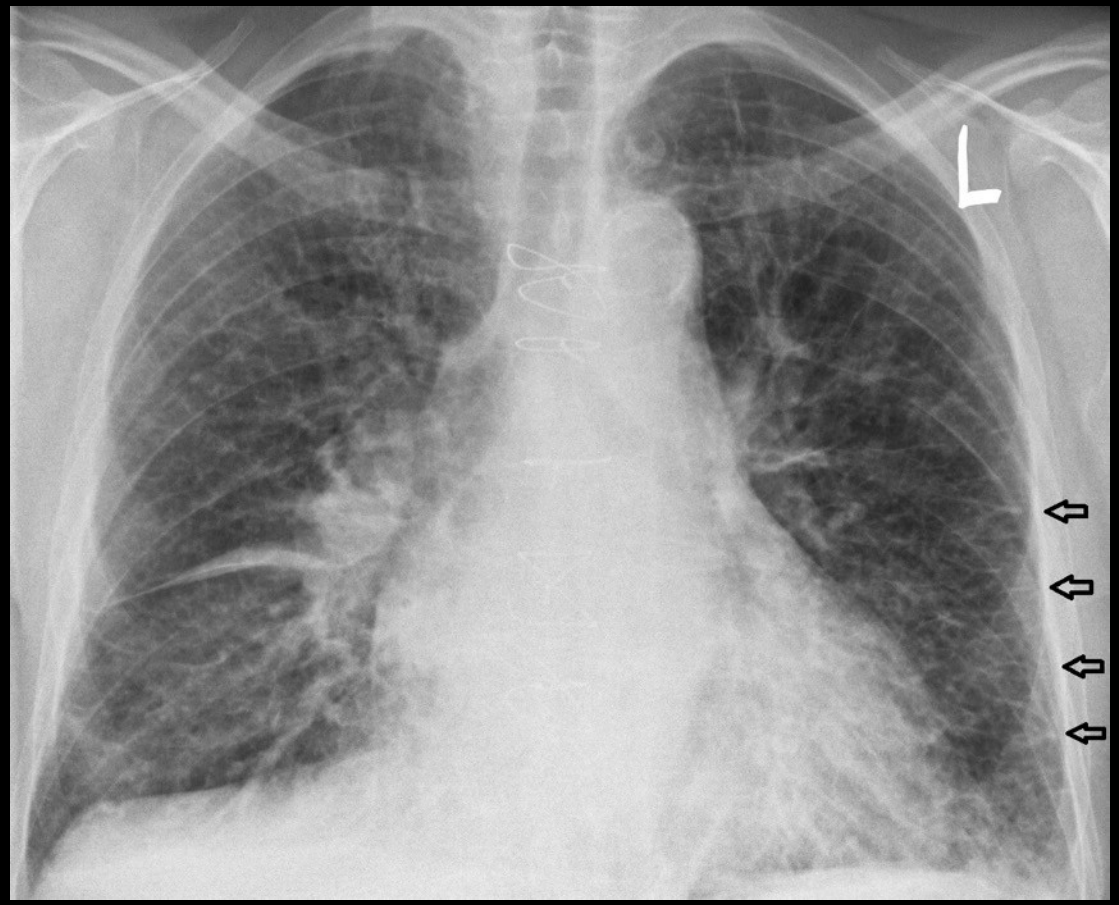
What is the underlying pathologic cause of Hampton’s hump?



CONCEPT QUESTION #2

Kerley B lines describe horizontal lines in the peripheral lung zones, seen in the setting of interstitial pulmonary edema.

What structure accounts for the horizontal lines?

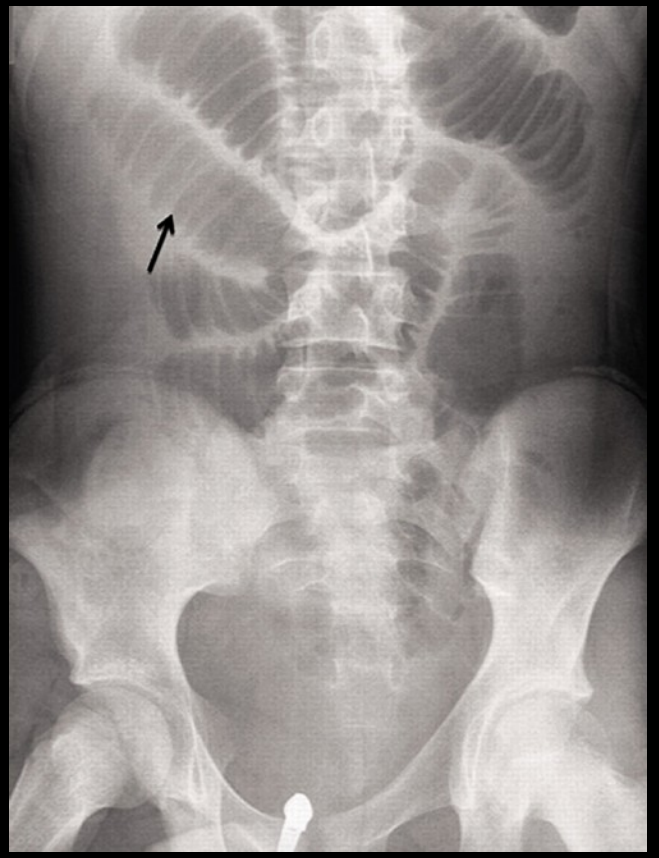


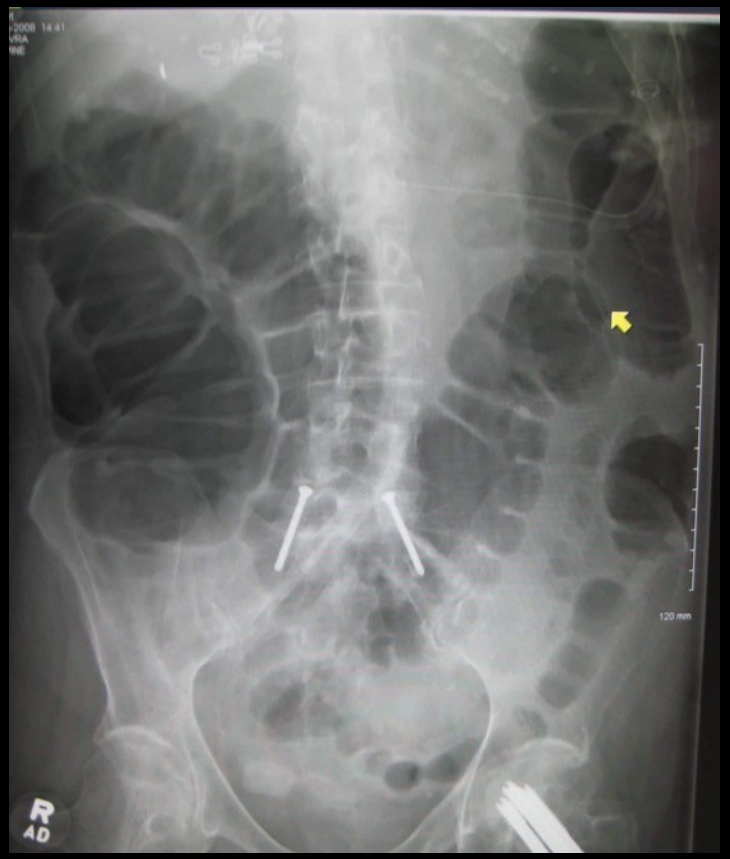
CONCEPT QUESTION #3

Small and large bowel loops can be distinguished by their mucosal folds. In the small bowel, they are closely spaced and extend across the entire lumen. In the large bowel, they are spaced further apart and are only rarely seen crossing the entire lumen.

What are the folds called in the small bowel?

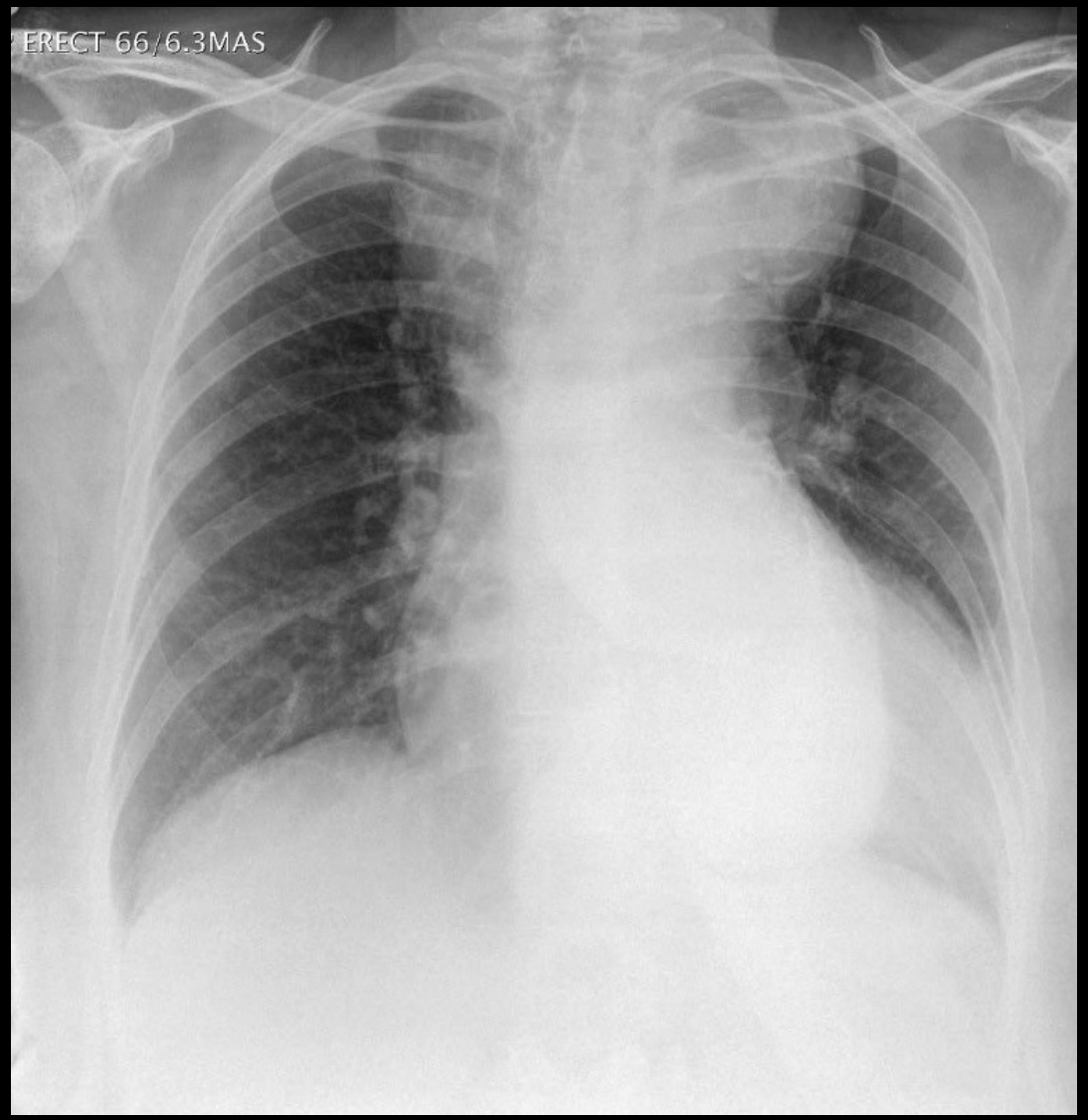
What are the folds called in the large bowel?x





CONCEPT QUESTION #4

In a trauma patient, what is the immediate concern based on this radiograph?



CONCEPT QUESTION #5

Multiple nodular ground glass opacities are seen in a patient with flu-like illness. In the worst cases, this disease can progress to ARDS.

What community-spread disease must be considered?